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A Q U A P H Y T E

CENTER FOR AQUATIC PLANTS

Institute Of Food And Agricultural Sciences
University Of Florida

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The U.S. Army Corps of Engineers, Waterways Experiment Station,
Aquatic Plant Control Research Program

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AQUATIC PLANTS AND CRANES

by Karen Brown, Information Specialist, IFAS Center for Aquatic Plants.

An interesting utilization of aquatic plants may be common knowledge to the avid birdwatcher while remaining unknown to the rest of us. The IFAS Aquatic Plant Information Retrieval System contains more than two hundred reports which include information on the habitat, breeding and food value relationships between water birds and aquatic plants. Many of these citations concern non-game wildlife species such as sandhill cranes (Grus canadensis).

There are six subspecies of sandhill cranes: the Florida (Grus canadensis pratensis) which is "threatened", the Mississippi (endangered), the Cuban (rare), the lesser, the Canadian and the greater. Sandhill cranes as well as most other crane species throughout the world build their nests almost exclusively with and among aquatic plants.

The Florida sandhill crane was first named the Savannah crane by William Bartram as he crossed Paynes Prairie (near Gainesville) 200 years ago. This crane species represents the only substantial population (four to six thousand) of non- migratory cranes remaining in North America. It occurs from the Okeefenokee Swamp in southern Georgia south through the Florida peninsula into Everglades National Park. The northernmost population of consequence in peninsular Florida, approximately 100 pairs, occurs in Alachua, Putnam and northern Marion and Levy counties, while the heart of its range is in central Florida along the Kissimmee River floodplain. Central Florida also is a major wintering range of the migratory greater sandhill crane (Grus canadensis tabida) from the north-central United States and Canada.

Florida sandhill crane nests are built in shallow wetlands where aquatic plants proliferate and provide nesting materials and cover. In central Florida 124 of 137 nests studied by Walkinshaw (1981) were constructed with pickerelweed (Pontederia lanceolata) and maidencane (Panicum hemitomon). It appears that cranes prefer to pull off stalks of maidencane

(See CRANES on page four...)

WHICH WAY IS WATERWAYS?

[This article is the first of a two-part series about the agencies which help fund the operation of the IFAS Center for Aquatic Plants' Aquatic Plant Information Retrieval System (APIRS).

APIRS is a technology-transfer system with a database of more than 25,000 books and reports about aquatic plant biology, ecology, control and utilization. APIRS provides information services, computer-generated "retrospective" and "current awareness" bibliographies of the literature, and reprints, to more than 500 aquatic plant researchers and managers, and provides AQUAPHYTE to more than 2,000. These services are provided free of charge.

The U.S. Army Corps of Engineers and the Florida Department of Natural Resources fund APIRS for users in the U.S. and Canada. (Provision of these services to other countries has been suspened until funding to pay the production and mailing costs for overseas clients is obtained.)

This article examines the Corps' Aquatic Plant Control Research Program. The next issue will focus on DNR's Bureau of Aquatic Plant Management.]

ASK ANYONE IN VICKSBURG,"Which way is Waterways?" Chances are high that you'll get the correct directions. You might say Vicksburg is a "Corps" town.

Vicksburg is a port city located on the western border of the state of Mississippi, more than two hundred miles from the sea. Its 35,000 residents have quite a view from the top of a bluff which overlooks a bend in the mighty Mississippi River.

Vicksburg also is home to a huge research complex, owned and operated by the United States Army Corps of Engineers, a major Army Command. This complex is known as the Waterways Experiment Station (WES). WES was established in 1929 and has become THE Corps' waterways research facility for the entire country. Col. Dwayne G. Lee is Commander and Director of WES, and Dr. Robert W. Whalin is Technical Director.

Everyone is welcome to visit WES and take either the guided or self-guided tour. But don't go on foot unless you really enjoy walking; WES covers about 700 acres. WES is an enormous research station, employing about 1600 researchers and staff to carry out its 100 million dollars worth of research programs. It has huge laboratories for the study of subjects such as river dynamics and flood control, earthquake effects, coastal engineering and, of course, high explosives. For example, large-

(See CORPS on page five)

AT THE CENTER

CENTER HAS NEW NAME

The CENTER FOR AQUATIC WEEDS as it has been known since its creation in 1978 has recently adopted as its official name THE CENTER FOR AQUATIC PLANTS. This change was made several years ago by the Florida Board of Regents but was not formally adopted due to the identity associated with the original name.

We at the Center still consider the management of nuisance aquatic vegetation to be a primary research and extension mission. However, it is felt the new name more adequately denotes the broader range of water resource management programs which have evolved within the Center.

Furthermore, plants that are weeds are still plants!

AQUATIC WEED VIDEOTAPE PROGRAMS AVALIABLE

Two videotape programs about aquatic weed problems and research recently have been completed by the Center and are available for general distribution.

The first, AQUATIC WEEDS IN FLORIDA, is a 16-minute public education program which introduces general audiences to aquatic weed problems and reviews the major aquatic weed management methods utilized by government agencies in Florida.

The second, THE IFAS CENTER FOR AQUATIC PLANTS, is a more technical program which reviews aquatic plant research work being conducted by scientists associated with the Center. This tape is 26 minutes long.

Copies of the 1/2 inch VHS videotapes are available at cost. For more information, contact the Center.

VISITING FULBRIGHT

Fulbright Scholar Dr. Mashhor Mansor of Malaysia selected the Center for an eight-month study of aquatic weeds and management practices in Florida. He is especially interested in waterhyacinths and hydrilla, two aquatic weeds most damaging to his country's food production. The scientist is on leave from the University of Science Malaysia (Penang), School of Biological Sciences. He arrived in Florida in December, 1986.

(See RICE PRODUCTION REDUCED BY WEEDS elsewhere in this newsletter.)

DRAWDOWN APPLICATIONS

Fluridone treatments in drawdown situations are being investigated by Center researchers Dr. William Haller, Dr. Kenneth Langeland and Mr. Dan Thayer.

The researchers are applying liquid and granular formulations of the herbicide to exposed hydrilla infestations in West Lake Tohopekaliga. As the lake level rises, they are monitoring hydrilla regrowth and new growth from hydrilla tubers and are performing herbicide residue analysis.

LAKE OKEECHOBEE

The Center is cooperating with several state and federal agencies in refining the aquatic plant management program for Lake Okeechobee.

For the Center, Dr. Kenneth Langeland attends inter-agency meetings with personnel of the South Florida Water Management District, the Florida Department of Natural Resources, the Florida Game and Fresh Water Fish Commission, the U.S. Army Corps of Engineers and others responsible for management of that large lake and the adjacent Everglades National Park. The Center provides technical expertise and helps explain aquatic plant management goals and methods to the public.

CITIZENS AND SCIENTISTS

Lake-dwelling citizens are helping university scientists in a new program that monitors water quality changes of Florida's lakes. In the program, lake association members take water samples and secchi depth readings, and deliver the samples and other data to Dr. Daniel Canfield and Dr. Joe Joyce, University of Florida IFAS scientists. The samples are analyzed for a variety of water quality parameters and for algal content.

In this way, researchers and citizens are made aware of changes in the lakes. As conditions warrant, various management programs may be initiated to slow or prevent lake deterioration.

The help of these conscientious citizens also saves researchers and others the expense of sampling the lakes themselves, a significant savings considering Florida has more than 7,000 lakes.

Canfield is a limnologist with the IFAS Department of Fisheries and Aquaculture.

UN-FAO OFFICER VISITS CENTER

Dr. Tomi Petr, Inland Fisheries Officer of the Food and Agriculture Organization of the United Nations in Rome, recently was welcomed to the Center by director Dr. Joseph Joyce and Dr. William T. Haller. Petr visited the Center in January, 1987.

During his stay, Petr learned about many of the Center's research, extension and education activities. He was interested in management techniques which could be utilized in FAO projects. He observed aquatic plant infestations and plant management operations throughout Florida, and visited a waterhyacinth-based wastewater treatment system in Orlando.

Petr also was interested in research work on the culture and use of the Chinese grass carp. Dr. Jerome Shireman, chairman of the IFAS Department of Fisheries and Aquaculture, demonstrated techniques for the production of triploid grass carp.

MORE HELP FOR AQUATICS

Dr. Donn Shilling, physiologist with the IFAS Agronomy Department, is conducting studies with researchers of the Center. Shilling received his Ph.D. from North Carolina State University and recently came to UF from the Monsanto Corporation in St. Louis.

Shilling is especially interested in the environmental fate (microbial decomposition, photolysis, partitioning, etc) of aquatic herbicides. Among other work, he and Dr. William Haller are investigating certain environmental influences on glyphosate efficacy, and are looking for ways to reduce application rates and improve management of submersed plants with fluridone.

Dr. Shilling's address is: IFAS Department of Agronomy, University of Florida, Mowry Road, Bldg. 164, Gainesville, Florida 32611. (904) 392-6180.

IT'S STILL FREE!

The Center's Aquatic Plant Information Retrieval System provides bibliographies of current and past aquatic plant research, including research on physiology, ecology, management and utilization. Information services are provided free of charge to researchers, managers and others in the United States and Canada.

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Dr. Joseph Joyce, Director

FLORIDA RESEARCH REVIEW

Plans for the restoration of Florida's Lakes Okeechobee and Apopka were the main subjects at this year's Aquatic Plant Research Review Meeting. The meeting was held at the University of South Florida (Tampa) in March. It was co-sponsored by the Center for Aquatic Plants, the USF CHEMS Center and the Florida Aquatic Plant Management Society.

Researchers discussed nutrient loading into the lakes and the effects of the Governor's temporary moratorium against herbicide application on Okeechobee. The 50-acre demonstration project using water-hyacinths to remove nutrients from Apopka was explained and research underway to help solve the lakes' problems were reviewed.

VISITING POST-DOC FROM SCOTLAND

Dr. Alison Fox, a visiting post-doctoral scientist from Scotland, is a recent addition to the staff of the Center. While in Florida, Dr. Fox will be working with Dr. William Haller on the ecology and management of cut-grass (Zizaniopsis miliacea). Dr. Fox received her Bachelor of Science (B.Sc.) degree from Liverpool University where she earned First Class Honors. She took her Ph.D. at Glasgow University's Botany Department in cooperation with the Freshwater Biological Association, under the supervision of Dr. Kevin Murphy. Working with Mr. D.F. Westlake, Fox's thesis project examined the efficacy and ecological impact of the management of submersed vegetation in flowing water. She also worked with the Nature Conservancy Council in England.

DIQUAT RE-REGISTRATION STUDIES

A diquat disappearance field study is being carried out by Dr. Kenneth Langeland and Dr. Joseph Joyce under a contract with Chevron Company as part of the re-registration process according to Environmental Protection Agency protocols.

In ponds stocked with catfish and tilapia, floating and submersed vegetation will be treated with diquat. The researchers will sample the ponds to determine how much diquat is partitioned into water, sediment, plants and fish. Samples will be sent to Chevron Chemical Companyfor analysis with the results going to the EPA for consideration.

COOPERATION IS THE KEY

Florida's two lead state agencies for aquatic plant management and research are the Department of Natural Resources Bureau of Aquatic Plant Management and the IFAS Center for Aquatic Plants. Coordinated efforts between the regulators, managers and the researchers is essential to solve the complex problems posed by plant infestations of our waters.

Mr. Dan Thayer helps coordinate the efforts of the DNR and the Center. He is a DNR Biological Scientist whose office is in the Center.

Thayer is well-known among aquatic plant managers and researchers in Florida. He has been a DNR regional biologist and is very active in the Florida Aquatic Plant Management Society.

Among his research activities, Thayer has studied the effects of waterhyacinth infestations and management methods on desirable native plants. He has found, for example, that the desirable plant, bulrush, can be "shaded-out" by competing waterhyacinth mats. In other work, he has studied the dispersion and partitioning of fluridone and has assisted in much of the work of DNR and the Center.

AQUATIC PLANT MANAGEMENT EXTENSION SERVICES

Two IFAS Extension Specialists provide state-of-the-art aquatic plant management knowledge to Extension Agents, plant managers, aquaculturists, farmers, ranchers and others throughout the state. They disseminate research information for practical use and conduct certification training. The Specialists also are an essential part of the "research feedback loop": they synthesize questions and comments from the field which help establish research priorities for aquatic plant problems.

Dr. Kenneth Langeland and Dr. Vernon Vandiver are the Specialists. In general, Langeland services the northern half of the state and Vandiver the southern half.

Their close cooperation with other agencies such as the Florida Department of Natural Resources and its seven regional biologists helps assure reliable and consistent flow of information between researchers, field personnel and the public. Langeland and Vandiver also maintain association with research faculty in other university departments to keep informed of current developments in other areas of science which affect or can be affected by aquatic plant management.

THE KEY TO WATERHYACINTH NUTRITION

British subject Ms. Susan Newman recently completed a two-year study of mineral deficiency symptoms and calcium nutrition of waterhyacinths. She came from the University of Manchester Institute of Science and Technology to take her Master of Science degree from the University of Florida IFAS Department of Agronomy. Her major professor is Dr. William Haller.

Newman's work stems from her interest in utilization of waterhyacinth for purification in secondary and tertiary wastewater treatment systems. She realized that wastewater frequently does not offer balanced growth media for the overlying waterhyacinths, resulting in unhealthy plants. For the systems to work, the plants must be growing vigorously.

Part of Newman's research resulted in the development of a visual key to nutrient deficiency symptoms of waterhyacinths. Her key includes photographs which show effects of nitrogen, phosphorus, sulfur, potassium, calcium, magnesium and iron deficiency on foliage and whole-plants. The key could be useful to managers of waterhyacinth-based wastewater treatment systems. It also could be used by water resource managers to indicate nutrient deficiencies in lakes and rivers.

Her work has verified that calcium is an essential element for waterhyacinth growth and has shown that healthy plants placed into solutions devoid of calcium will die within two weeks. She has determined that the critical calcium concentration in waterhyacinth tissue is about 7,500 ppm. Below the critical concentration, plant growth is significantly reduced. To maintain the critical calcium concentration (under laboratory conditions), a nutrient solution containing 7.5 to 10 ppm calcium is required. Calcium deficiency first shows up as brown spotting on the leaves.

(CRANES from page one...)

with which they build their nests in patches of pickerelweed. Other plants used for nestbuilding include St. John's wort (Hypericum fasciculatum), arrowleaf (Sagittaria lancifolia), bluestem (Andropogon floridanus), bulrush (Scirpus spp.), spikerush (Eleocharis equisetoides), and waterhyacinth (Eichhornia crassipes). In areas of deeper water, some nests are built on large floating sudds of Hydrocotyle or Utricularia. Plants also conceal nesting cranes; frequently, nesting birds are not visible from 10 to 15 meters away.

The average nesting marsh is approximately five hectares, with the most common nesting areas occurring in pickerelweed ponds containing 12-18 inches of water. Most nesting takes place between February and May, with nest construction and egg-laying occurring over a period of 7-10 days. Although Florida sandhill cranes nest almost exclusively in ponds and on the margins of lakes and marshes, the birds also use upland areas for feeding.

Water level is the primary factor determining whether or not cranes will nest. Therefore, wetland drainage and long-term droughts have critical effects on crane populations. Heavy rainfall after incubation begins can flood nests and they will be abandoned: however the extended breeding season of this crane often allows it to renest within the same season. If environmental conditions remain relatively similar, cranes yearly will return to the same nesting areas. The cranes' extensive use of these aquatic habitats make them an excellent wetland indicator species.

A major factor contributing to the decline of the Florida, Mississippi and Cuban sandhill cranes is loss of habitat. Development of central Florida's prairie country and ranchlands, pond drainage for irrigation purposes, channelization, replacement of ranching by crop farming, as well as natural factors such as droughts and floods, all contribute to the decline of sandhill crane populations in Florida.

Ranchers have proven to be conscientious conservationists who can improve the situation by building their stock ponds with shallow ends so that aquatic plants can establish to provide nesting habitat. It has been documented that marshy fields which have been flooded attract nesting cranes.

Cranes reportedly are quite "tame" when undisturbed and have been observed nesting within sight of ranch houses as well as crossing ranch yards with small chicks. One pair reportedly nested for seven years on Lake Placid Golf Course in a pond covered with emergent vegetation, passed daily by golfers. This surprising occurrence perhaps indicates one benefit of allowing some vegetation to remain in and around managed ponds.

(Some information for this article was provided by Stephen Nesbitt of the Wildlife Research Laboratory of the Florida Game and Fresh Water Fish Commission, Gainesville, and by Mary Bishop, a Ph.D. student in the IFAS School of Forest Resources and Conservation, Department of Wildlife and Range Sciences.)

EMINENT SCHOLAR SELECTED

The Carl S. Swisher Chair of Water Resources soon will be occupied. Dr. Claire L. Schelske, limnologist from the Great Lakes Division of the University of Michigan, will arrive at the University of Florida's Institute of Food and Agricultural Sciences (IFAS) in summer 1987. The Swisher Chair is part of the IFAS Department of Fisheries and Aquaculture.

Schelske's major professional interests include paleolimnology, the tracing of lake histories through studies of sediments. Other major interests include the study of factors which control primary productivity and eutrophication. Schelske has been with the University of Michigan (Ann Arbor) for twenty years. He is a professor of natural resources.

His new address will be: Department of Fisheries and Aquaculture, Institute of Food and Agricultural Sciences, University of Florida, 7922 N.W. 71st Street, Gainesville, Florida 32606.. (904) 392-9613.

BOOKS/REPORTS

AN ECONOMIC ANALYSIS OF THE BENEFITS OF AQUATIC WEED CONTROL IN NORTH-CENTRAL FLORIDA WITH SPECIAL REFERENCE TO ORANGE AND LOCHLOOSA LAKES by J.W. Milon, J. Yingling and J.E. Reynolds. 1986. Economics Report 113. 52 pages. (This report is free from the IFAS Center for Aquatic Plants.)

The authors found that the sport fishery of two large lakes make a significant contribution to the local economy: almost $11 million a year in "total economic activity." They provide evidence that aquatic plant management costs are a major reason for such a high economic impact.

AQUATIC PLANTS FOR WATER TREATMENT AND RESOURCE RECOVERY ed. by K.R. Reddy and W.H. Smith. 1987. Magnolia Publishing Company, 5260 Chatsworth Court, Orlando, Florida 32806. (305) 275-7571. 800 pages. $80.00

This is the Proceedings of the International Conference on Aquatic Plants for Water Treatment and Resource Recovery, held in Florida in 1986.

MANUAL DE HERBARIO, Administracion y Manejo de Colecciones, Tecnicas de Recoleccion y Preparacion de Ejemplares Botanicos, comiled by A. Lot and F. Chiang. 1986. Consejo Nacional de la Flora de Mexico, A.C., Departamento de Botanica, Instituto de Biologia, UNAM, Apdo. Postal 70-233, 04510 MEXICO, D.F. 144 pages. $6.00.

This is a Spanish-language manual on how to collect and prepare botanical samples for long-term preservation in herbaria.

AQUATIC PLANTS OF OKLAHOMA I: Submersed, Floating-leaved and Selected Emergent Macrophytes by E.N. Nelson and R.W. Couth. 1985. Dr. Richard Couch, Biology Department, Oral Roberts University, Tulsa, Oklahoma 74171. 113 pages. $5.00.

WATERHYACINTH. Biology, Ecology and Management by B. Gopal. 1986. Elsevier Science Publishers, P.O. Box 211, 1000 AE Amsterdam, The Netherlands. 484 pages. US $122.25 or Dfl.275.00.

This is a review of the current knowledge on all aspects of waterhyacinth biology, ecology, utilization and management and includes a bibliography of more than 2700 references.

HOW TO IDENTIFY AND CONTROL WATER WEEDS AND ALGAE. 4th edition. Applied Biochemists, Inc., 5300 W. County Line Road, Mequon, Wisconsin 53092 (414) 242-5870. 1987. 108 pages. US $6.

THE FAMILY OF LEMNACEAE - A MONOGRAPHIC STUDY. (Volume 2 of the series: Biosystematic Investigations in the Family of Duckweeds (Lemnaceae). by E. Landolt. 1986. Veroffentlichungen des Geobotanischen Institutes ETH, Stiftung Rubel, Zurichbergstrasse 38, CH-8044 Zurich, SWITZERLAND. 566 pages.

This massive review tells what is known about the morphology, karyology, habitat, distribution, taxonomy and nomenclature of Lemna, Spirodela, Wolffia and Wolffia.

AZOLLA PINNATA VAR. AFRICANA. by P.A. Reynaud and C. Franche. 1986. Editions de l'ORSTOM, Librairie-Diffusion, 70 Route d'Aulnay, F 93140 BONDY, FRANCE. 15 pages.

This colorful booklet summarizes in French and English the aquatic plant Azolla pinnata, with particular attention to its nitrogen-fixing symbiont and azolla's use as a green manure.

PURIFYING CADMIUM AND NICKEL-CONTAINING WATER BY WATER HYACINTH (EICHHORNIA CRASSIPES (MART.) SOLMS) AND THE SUBSEQUENT UTILIZATION OF BIOMASS PRODUCED FOR METHANE PRODUCTION. by B. Kaigate. 1987. Ph.D. Thesis, University of Savoy, B.P. 1105, 73011 Chambery Cedex, FRANCE. 211 pages.

This French-language study tested the ability of waterhyacinth to remove heavy metals from the water and then be used for biogas production. The author found no significant effects by cadmium and nickel on the production of biogas.

RIVER PLANTS OF WESTERN EUROPE: The Macrophytic Vegetation of Watercourses of the European Economic Community. by S.M. Haslam. 1987. Cambridge University Press, 32 East 57th Street, New York, New York. 10022. 512 pages. $125.00.

"This book describes and discusses, from various aspects, the vegetation of rivers and other watercourses in Western Europe. Distributional, community and historical ecology are stressed rather than physiological and productivity studies."

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scale, finely detailed models of Niagara Falls and other major water systems are sheltered by airplane hangar-sized structures. Multi-story buildings are filled with instrumentation for the study of physics, chemistry and biology. WES also is a designated arboretum which surrounds a lake and has a 1/2 mile nature trail.

The six major laboratories of WES are Hydraulics, Information Technology, Geotechnical, Structures, Coastal Engineering and Environmental. Other elements handle procurement, construction, instrumentation, and so on.

ENVIRONMENTAL LABORATORY

WES's Environmental Laboratory (EL), headed by Dr. John Harrison, "investigates the effects of water resources development projects on the environment, and the interaction between military activities and the environment. Studies include all aspects of research pertinent to environmental protection policy, legislation, and regulation," an encompassing research responsibility.

WES-EL has four divisions and is responsible for several major Corps research programs, including Natural Resources, Water Quality, Environmental Impact, Effects of Dredging and Aquatic Plant Control Research.

AQUATIC PLANT CONTROL RESEARCH PROGRAM

Part of the Corps' responsibility is to maintain the navigable waters of the United States. A number of aquatic plants such as waterhyacinth (Eichhornia crassipes), hydrilla (Hydrilla verticillata) and Eurasian watermilfoil (Myriophyllum spicatum) seriously hinder navigation. Even the most casual of observers know ways that these pests affect navigation and many other uses of water bodies. The mission of the WES-EL Aquatic Plant Control Research Program (APCRP) is to find ways to manage these weeds.

The APCRP is the WES unit with which many non-Corps botanical scientists are in constant contact. The program started in 1974 and has an annual budget of $2.5 million. Some scientists associated with the IFAS Center for Aquatic Plants perform research contracted by APCRP. These studies take place at the University of Florida, but are administered and monitored by APCRP. APCRP has research ties to other universities and government agencies as well.

APCRP research is well-known among aquatic ecosystems scientists throughout the world. (See PUBLICATIONS LIST.) The program conducts and sponsors research on all aspects of aquatic plant ecology, physiology, control and utilization..

Environmental engineer Mr. J. Lewis Decell is the APCRP program manager. Decell is responsible for planning, development, funding and execution of the Corps' research program on aquatic plants. He reports through WES to the Chief of Engineers in Washington.

Decell says, "If you wait until aquatic weeds are a problem, then you're not really managing." Therefore, major research of APCRP includes developing better techniques for aquatic plant management.

Much is being said lately about "the best level of control" for exotic aquatic plants. According to Decell, "The degree of management needed depends on the plant which is the nuisance, the individual water body and the valued uses of that water body."

Decell believes "valued uses" should be defined only after the local and regional public which uses the water body have voiced their opinions during public hearings. Decell says "Bring in the public early." Their "natural appreciation" for the water body must be considered when defining management objectives. "After all, public use of water bodies is as characteristic of many systems as are water chemistry and sediments."

And APCRP does study water chemistry and sediments. In fact, much of APCRP's work appears to have little to do with aquatic plants. This is ecosystem research -- essential to the main job, which is to manage weeds in the safest way possible.

As program manager, Decell has committed APCRP to increased development of biological control because biological control is the only method with built-in management. "You spend the necessary time now and you won't have to do more later."

APCRP is comprised of several groups, each with research teams that delve into different areas of aquatic plant research.

BIOENGINEERING

Mr. Edwin A. Theriot leads the Aquatic Habitat Group. Theriot's (Terry-oh's) group has begun a 10-year project which is at the forefront of technological and biological research. The project is part of APCRP's recently established long-term research emphasis on "bioengineering".

APCRP researchers believe it is possible to "genetically engineer" microorganisms which attack specific plants such as hydrilla or Eurasian watermilfoil (Myriophyllum spicatum). Their goal is to develop an inoculum which may later be developed into microbial herbicides.

Encouraged by the success of Dr. Haim Gunner of the University of Massachusetts, they are "cautiously optimistic" that they will succeed. Under a research contract to WES, Gunner has isolated bacterial and fungal organisms from Eurasian watermilfoil and has shown that the organisms can control the plant under simulated field conditions.

Theriot and his colleagues expect to "build a pathogen". To help guide their project, the APCRP has retained an independent panel of genetic engineering and ecology experts from around the U.S. In a recent report the panel stated, "Existing technology in bioengineering is sufficiently advanced to produce a microorganism effective in biological control of submersed aquatic plants. The tools are available and [many of] the necessary steps have been performed with microorganisms for other purposes."

Theriot's group is in the first stages of research. They are identifying organisms which attack hydrilla and Eurasian watermilfoil and are also studying lectin-protein interactions within hydrilla leaves. The group has already collected several hundred naturally occuring organisms from hydrilla and watermilfoil. From those, according to Theriot, they have found no major pathogens which act against the plants in this country.

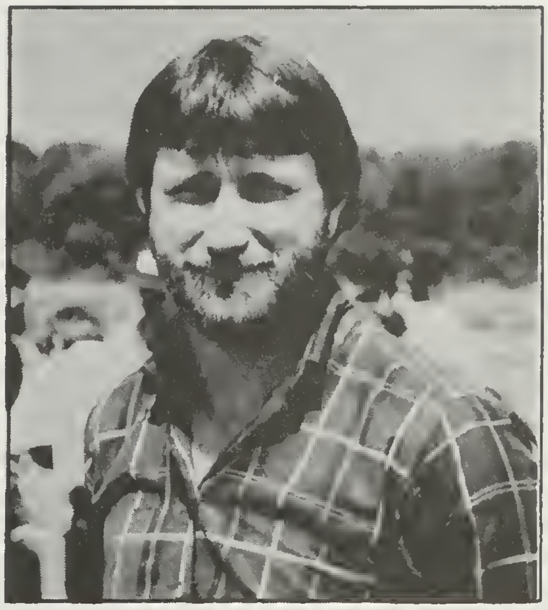
Once microorganisms are selected, they are tested for host- specificity. The candidate-organism for engineering must be proven to be exclusively associated with the target plant before the next steps in the process can be taken. As part of the effort, researchers at the University of Wisconsin are developing a modified profusion chamber in which sample organisms can be tested for host-specificity.

When a host-specific candidate is selected, its physiology, reproduction and mode of specificity must be studied. Then WES researchers will define a trait which, when genetically introduced, may cause the organism to become pathogenic to the target plants. This process is made somewhat easier by the fact that "gene banks" already exist. Gene banks are repositories of genes which have been isolated and whose traits are known. The researchers can order genes which they believe will cause the candidate organism to become pathogenic.

The WES researchers will then "insert" a gene into the candidate's genetic material and test the resulting organism to see if the gene was accepted and if the gene is "expressed" (the gene's traits are shown) in the organism's offspring. If so, the engineered organism is then tested against the plant target. If the new organism is not pathogenic, the researchers begin again in this time-consuming process.

When the researchers succeed in buildin

(See CORPS on page six...)



Mr. Theriot

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g an organism which is exclusively pathogenic to the target plant, they will culture the new organism and produce an inoculum. After further research, APCRP may invite private corporations to help develop aquatic microbial herbicides. Before any resulting herbicides can be tested outside the laboratory, however, the U.S. Environmental Protection Agency must give its approval. EPA is the agency responsible for both synthetic and microbial herbicide registration and labeling.

Dr. Cofrancesco

PROGRESS IN THE FIELD

Dr. Al Cofrancesco is an entomologist for the Biological Team, one of two groups of researchers of the Aquatic Habitat Group. Cofrancesco is primarily responsible for the Corps' "classical" biological control projects which use insects, saying that biological control is "the most natural way" to control problem plants.

Recently, Cofrancesco presided at insect releases which should help control hydrilla and waterlettuce in Florida. (See WATER LETTUCE BIOCONTROLS RELEASED and FIRST TIME FOR INSECT CONTROL OF HYDRILLA on page seven..)

In the 1960s, Corps-sponsored research resulted in the biological control with insects of the emergent plant alligatorweed (Alternanthera philoxeroides). It took only four years to find a biological control for alligatorweed and release it into Florida's waters where it no longer is a signifcant problem. Cofrancesco believes that some people have been "spoiled" into believing that biological control of hydrilla could be equally easy. On the other hand, other people "are skeptical that biocontrols will be found for submersed plants."

Cofrancesco conducts his own biocontrol research, and also is responsible for selecting and monitoring contract-scientists who perform other biocontrol research for the Corps. Corps- sponsored insect biocontrol research is being carried out for hydrilla, waterhyacinths, water lettuce and Eurasian watermilfoil. According to Cofrancesco, the Corps funds 80-90% of all U.S. biological control work for aquatic plants.

COMPUTER SIMULATIONS

Mr. H.W. West leads APCRP's Environmental Analysis Group. After researchers develop aspects of control technologies (for example, grass carp stocking rates), this group develops computer models. These interactive models incorporate research results to predict plant control. The models aid other APCRP research work, and can be used by aquatic plant managers. (See FREE COMPUTER PROGRA<S AVAILABLE.)

West calls the models "decision tools for managers." The models try to "bring together all understanding of how treatment techniques [machines, herbicides and biocontrols] interact with plants and the rest of the ecosystem."

Use of the models also helps to find "gaps" in aquatic plant control knowledge. Researchers and managers use the models as a "feedback loop" between technology and field programs. In this way, the models are refined and made more accurate.

The models and the data they use will be brought together for "knowledge-based 'expert' systems", a future project of the Environmental Analysis Group.

PLANTS AND HERBICIDES

The Aquatic Processes and Effects Group, led by Dr. T.L. Hart, is where most of APCRP's herbicide and ecology work is performed.

Members of the Chemical Team (Dr. H. Westerdahl, Dr. K. Getsinger, Dr. K. Luu, Mr. G. Pesecreta and Mr. W. Green) study the efficacy and effects of herbicide use.

When the floating plant waterhyacinth was the major problem aquatic weed, her-

(See CORPS on page seven...)

FREE COMPUTER PROGRAMS AVAILABLE

Computer programs that simulate mechanical control operations and determine stocking rates for grass carp are available free of charge from the U.S.Army Engineer Waterways Experiment Station. The programs were developed by the Corps' Aquatic Plant Control Research Program's Environmental Analysis Group; Mr. H.W. West, Group Leader. Other computer programs that predict biological control success using insects and help manage herbicidal control operations are being developed.

HARVEST is an aquatic plant mechanical control simulation model. It is used to estimate the time and costs of control operations according to the specific harvesting systems used. The program can be used to select the most cost-effective equipment for a specific harvesting situation and can determine how equipment modifications would affect overall production rates.

HARVEST "takes all important environmental, operational and mechanical characteristics into account to simulate an operation." The user answers 19 questions, such as "what is the cutter width of the machine?", "what is the transporter's capacity in tons?", "what is the mean plant density at the site?", "what is the water current speed?" and "what is the hourly rental cost for each piece of equipment used?". The computer uses these answers to predict the time and cost required for harvesting, transporting and trucking aquatic plant material. The output summary lists 18 separate results, such as amount of material harvested in a swath, time wasted by harvester, optimal number of trucks required, and expected tons and acres harvested per hour.

The WHITE AMUR STOCKING RATE MODEL is used to determine the best number and size of grass carp to stock for the control of hydrilla to a specified level in lakes or ponds. The program will forecast the amount of hydrilla remaining and the number and size of grass carp expected to be present after a specified number of months.

AMUR requires the input of seven variables including the initial hydrilla biomass present, the biomass of the grass carp to be stocked, and the duration of the forecast. Using the process of elimination, the user can determine the best stocking rate according to the money available for the purchase of fish or the desire for a certain level of control within a certain time period. Built-in routines in the program manipulate the variables that determine hydrilla growth (such as season, photoperiod, temperature and so on). The program also automatically calculates grass carp growth, survival and plant consumption.

INSECT is a third program and probably will be available through the Waterways Experiment Station in the first quarter of 1988. It is being developed to assist managers in using the biological agents, Neochetina spp., to control waterhyacinths.

Specifically, INSECT will predict the effectiveness of the weevils for up to a three-year period. The program will also predict uncontrolled waterhyacinth growth in systems defined by the user. INSECT requires the input of local weather conditions for its calculations, but automatically accounts for plant biomass, number of leaves, detritus, insect mortality, and number of eggs, larvae, pupae and adults and their feeding effects. Simulation results are based on specified time frames selected by the user.

It is expected that other biological control insects and plants will be modelled and included in INSECT.

(These free programs and their documentation can be obtained from Mr. J. Lewis Decell, Program Manager, U.S.Army Corps of Engineers, Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi 39180.)

(CORPS from page six...)

bicide technology was somewhat simpler than it is today. For most floating and emergent plants, herbicide application requires simple aerial contact with the exposed leaves and stems. Now that submersed exotic plants have invaded the U.S., the Corps is helping to develop a completely different herbicide technology, concentrating on the application of herbicides in flowing waters, the use of adjuvants which hold herbicides to the submersed plants and which slow the rate of dilution and dispersal, and application techniques which cause more of the herbicide to reach the target for longer periods of time.

Recent studies by Dr. Westerdahl, for example, are helping to determine if the herbicide triclopyr (Garlon) could be used for submersed aquatic plant control. Extensive laboratory and field testing of target and non-target organisms, herbicide residue partitioning and water quality are standard in the work of the Chemical Team.

The Ecology Team focuses on the aquatic plants themselves. Dr. J. Barko, Dr. R. Chen and Dr. R.M. Smart use large greenhouses to study the phenology, photosynthesis, reproduction, nutritional requirements and nutrient uptake of the plants and to examine the ecological conditions required for their growth.

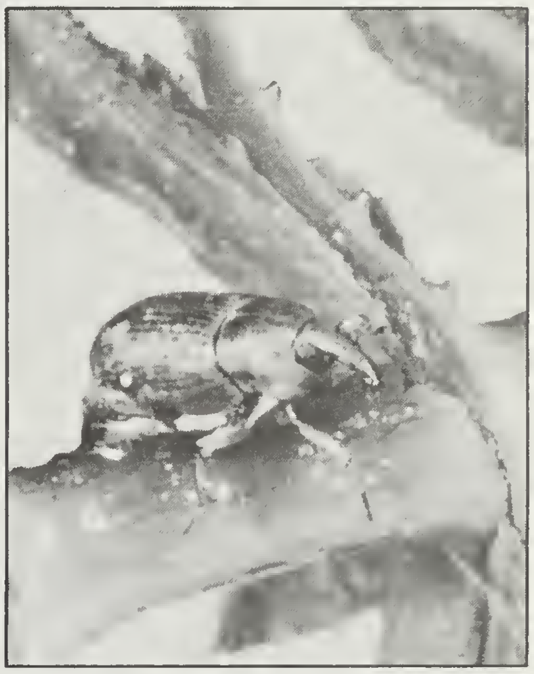
Dr. Michael Smart has been with WES for 13 years. His major interests are nutrient uptake by Eurasian watermilfoil, effects of water chemistry on milfoil photosynthesis, and competition between hydrilla and vallisneria.

The work of the Ecology Team is varied. Among others, Smart and Dr. Barko have authored research papers on the effects of water chemistry on Eurasian watermilfoil, effects of salinity and nutrients on certain salt marsh plants, and the ecology of the little-studied plant, giant cutgrass (Zizaniopsis miliacea). They also have produced a "how-to" manual for the laboratory culture of rooted submersed plants.

Recent work by the Ecology Team indicates that the sediment rather than the water above it is the primary source of phosphorus and nitrogen for Eurasian watermilfoil growth. However, another growth nutrient, potassium, appears to be taken up mainly from the water by milfoil. These

(See CORPS on page eight...)

FIRST TIME FOR INSECT CONTROL OF HYDRILLA VERTICILLATA



The first use of insects for biological control of the nuisance aquatic plant hydrilla (Hydrilla verticillata) began April 30 as reporters, cameramen and government officials looked on. Twelve hundred tiny weevils (Bagous affinis) were released onto the exposed shoreline of West Lake Tohopakaliga in Kissimmee, Florida. The weevils are native to India and Pakistan where their larvae feed on the reproductive tubers of the Hydrocharitaceae family, especially hydrilla. Scientists expect that controlling the tubers will curtail the regrowth of the wanton weed.

Representing the U.S. Army Corps of Engineers Waterways Experiment Station (W.E.S.), the prime research sponsor, entomologist Dr. Al Cofrancesco poured the foreign weevils onto the sand and watched as they sought shelter in the cool handful of hydrilla thrown on top of them. Entomologists Dr. Gary Buckingham (USDA), Ms. Christine Bennett (IFAS, UF), Dr. Ted Center (USDA) and Mr. Wiley Durden (USDA) also were present for the historic event.

Buckingham and Bennett cultured the insects successfully in 1983 after receiving them from IFAS entomologist Dr. Joseph Balciunas. Balciunas had re-discovered them during an international survey trip, with the help of the Commonwealth Institute of Biological Control - Pakistan. Dr. Center decided how many weevils to release.

In quarantine studies performed by Buckingham and Bennett, it was learned that the weevils lay their eggs in wood or other organic matter in the soil. When the eggs hatch, the larvae search out hydrilla tubers under the soil, using them for food and shelter until they hatch in about 12 days. One or more larvae can hatch inside a single tuber, but one larvae is enough to decimate it. The larvae cannot survive under water so they are only effective in draw-down or drought conditions where they can search out tubers buried in the soil. Lake Tohopakaliga was chosen as a release site because it is now drawn down. Some of the weevils also were released into buckets so that they can be retrieved and monitored during the experiment. The other way to judge their effectiveness will be to watch for the regrowth of hydrilla when the lake is again flooded.

Adults feed on stems, leaves and turions of hydrilla that are not submerged. Under laboratory conditions, adult females live approximately 128 days, reaching sexual maturity 5-7 days after emergence. They lay an average of 220 eggs during their lifespan. The quarantine lab in Gainesville has retained several specimens with which to culture another group of the insects.

(CORPS from page seven...)

findings have implications about the systems watermilfoil will infest and about how best to manage the weed.

In other work, the researchers have found that adding organic matter to sediments inhibits the growth of rooted submersed plants and that as little as 5% by weight is enough organic matter to be toxic to the plants.

The Ecology Team also is searching for plants that will compete with weedy species, especially after the weeds have been treated with mechanical and/or herbicidal controls. The point is to "find ways to establish non-problem plants before the weedy species again take over."

The Aquatic Plant Control Research Program studies ways to help keep the nation's waterways navigable. The results are applicable to aquatic plant management everywhere. APCRP maintains research programs and information-sharing programs to assure that results are given timely and the widest possible circulation. In this way, aquatic plant researchers and managers everywhere benefit from the work of APCRP and the Corps' Waterways Experiment Station.

Next time you're in Vicksburg, just ask, "Which way is Waterways?" You'll get there.

V.R.

The Waterways Experiment Station
Program Manager, APCRP
WESEP-A
U.S. Army Corps of Engineers
P.O. Box 631
Vicksburg, Mississippi 39180
(601) 634-3494

Dr. Smart

This is a listing of recent recent reports and bulletins issued by WES-EL-APCRP.

Large-scale operations management test (LSOMT) of insects and pathogens for control of waterhyacinth in Louisiana. Volume II. Results for 1982-1983. D.R. Sanders; E.A. Theriot. Technical Report A-85-1. December 1986. 57 pp.

Biological control agents of Hydrilla verticillata; final report on surveys in East Africa, 1981-1984. R.H. Markham. Miscellaneous Paper A-86-4. July 1986. 34 pp.

Evaluation of 2,4-D/adjuvant mixtures in flowing water. K.D. Getsinger; H.E. Westerdahl. Miscellaneous Paper A-86-3. May 1986. 31 pp.

Effects of water chemistry on aquatic plants: growth and photosynthesis of Myriophyllum spicatum L. R.M. Smart; J.W. Barko. Technical Report A-86-2. May 1986. 72 pp.

Bioengineering technology meeting, September 28-29, 1983. J.C. Pennington. Miscellaneous Paper A-86-1. March 1986. 38 pp.

Final report on the overseas surveys (1981-1983) for insects to control hydrilla. J.K. Balciunas. Technical Report A-85-4. December 1985. 93 pp.

Monoecious Hydrilla in the Potomac River. Miscellaneous Paper A-85-5. August 1985. 223 pp.

Evaluation of polymers for controlled delivery of herbicides for aquatic plant control. F.W. Harris. Technical Report A-85-2. June 1985. 91 pp.

Biological control of Hydrilla verticillata (L.f.) Royle with lytic enzyme-producing microorganisms. J.C. Pennington. Technical Report A-85-3. September 1985. 41 pp.

A mathematical model of submersed aquatic plants. C.D. Collins; R.A. Park; C.W. Boylen. Miscellaneous Paper A-85-2. May 1985. 37 pp.

Large-scale operations management test (LSOMT) of insects and pathogens for control of waterhyacinth in Louisiana. Volume 1: results for 1979-1981. D.R. Sangers; E.A. Theriot; P. Perfetti. Technical Report A-85-1. January 1985. 104 pp.

Culture methodology for experimental investigations involving rooted submersed aquatic plants. R.M. Smart; J.W. Barko. Miscellaneous Paper A-84-6. November 1984. 20 pp.

Management of Eurasian watermilfoil in the Columbia River Basin. K.J. Killgore. Miscellaneous Paper A-84-7. December 1984. 53 pp.

Mortality of third instar Sameodes albiguttalis larvae due to constant low temperature exposures in the laboratory. R.M. Stewart. Miscellaneous Paper A-85-1. February 1985. 22 pp.

Use of herbicide/adjuvant formulations for the control of Myriophyllum spicatum L. K.J. Killgore. Miscellaneous Paper A-84-8. December 1984. 64 pp.

Handbook for obtaining and using aerial photography to map aquatic plant distribution. J.M. Leonard. Instruction Report A- 84-2. 40 pp.

Delineation of wetland boundaries using vegetation within the Altamaha River Basin of Georgia. B.F. Vaughan; R.J. Cooper; J.H. Braswell; R. Hart. Technical Report Y-84-1. April 1984. 70 pp.

Fish of two dike pools in the lower Mississippi River. R.W. Nailon; C.H. Pennington. Technical Report E-83- . September 1983. 87 pp.

Field evaluation of Garlon 3A (Triclopyr) and 14-ACE-B (2,4- D BEE) for the control of Eurasian watermilfoil. K.D. Getsinger; H.E. Westerdahl. Miscellaneous Paper A-84-5. September 1984. 25 pp.U.S. Department of Agriculture/Corps of Engineers Cooperative Aquatic Plant Control Research - Annual Report for FY 1982. Biological and Chemical Control Technologies. Miscellaneous Paper A-84-2. August 1984. 227 pp.

Evaluation of Fusarium roseum 'culmorum' as a biological control agent for

WATER LETTUCE BIOCONTROLS RELEASED

Large-scale biological control of water lettuce (Pistia stratiotes) in the U.S. now is being tested for the first time. One thousand exotic insects which thrive on the aquatic weed were released April 29 on Lake Okeechobee, Florida. Researchers believe the insects will reproduce to millions within months and provide perpetual control of the plant in Florida within two or three years. The success of the project would greatly reduce the impact of this prolific mosquito-harboring plant and the use of herbicides to control it.

The release was made by personnel of the U.S. Army Corps of Engineers' Waterways Experiment Station and the Corps' Jacksonville District Office. Research for the project was conducted under a Corps contract to Dr. Dale Habeck and Dr. Catherine Thompson of the IFAS Department of Entomology and Nematology at the University of Florida, through the Center for Aquatic Plants.

Successful biological control of water lettuce in Australia led Habeck and Thompson to study the aquatic weevil native to Brazil, Neohydronomus pulchellus. They imported several insects to study their biology and host-specificity, and to culture large numbers for field release.

In quarantined studies, the weevil was tested for feeding and egg-laying preference on thirty-seven plant species. In "choice" tests, feeding and oviposition was observed only on water lettuce, verifying field reports that N. pulchellus does not occur on any plant except water lettuce.

Adults of the 2 mm-long insect feed on the plant leaves, making characteristic round holes. Each adult female lays one egg per day in the leaves. When the larvae hatch, they begin mining the leaves, where they complete larval development and pupate. Development from oviposition to adult emergence takes approximately one month. Ten to twelve weevils can kill one water lettuce plant.

These tests convinced state and federal agencies that the insects could safely be released in the first large-scale test of biological control of water lettuce in this country.

Technologies. Miscellaneous Paper A-84-2. August 1984. 227 pp.

Evaluation of Fusarium roseum 'culmorum' as a biological control agent for Hydrilla verticillata. R. Charudattan; T.E. Freeman; R.E. Cullen; F.M. Hofmeister. Technical Report A-84-5. August 1984. 44 pp.

Field methods to measure aquatic plant treatment method efficacy. K.J. Killgore; B.S. Payne. Miscellaneous Paper A-84- 3. April 1984. 28 pp.

Rearing, storing, and efficacy studies on Arzama densa for release programs against waterhyacinth. R.G. Baer; P.C. Quimby. Technical Report A-84-4. May 1984. 40 pp.

Use of the white amur for aquatic plant management. A.C. Miller; J.L. Decell. Instruction Report A-84-1. August 1984. 48 pp.

Mechanical harvesting of aquatic plants. Report 3. Evaluation of the limnos system. J.L. Smith. Technical Report A-78-3. May 1984. 41 pp.

Effects of endothall treatment on phosphorus concentration and community metabolism of aquatic communities. W.F. James. Miscellaneous Paper A-84-1. February 1984. 83 pp.

Richard B. Russell Dam and Reservoir: potential water quality effects of initial filling and decomposition of vegetation. D. Gunnison; J.M. Brannon; R.L. Chen; I. Smith; T.C. Sturgis. Miscellaneous Paper E-84-2. January 1984. 66 pp.

Growth response of Myriophyllum spicatum and Hydrilla verticillata when exposed to continuous, low concentrations of fluridone. J.F. Hall; H.E. Westerdahl; T.J. Stewart. Technical Report A-84-1. January 1984. 31 pp.

Efficacy of Sameodes albiguttalis as a biocontrol of waterhyacinth. T.D. Center; W.C. Durden; D.A. Corman. Technical Report A-84-2. January 1984. 248 pp.

Interactive influences of light and temperature on the growth and morphology of submersed freshwater macrophytes. J.W. Barko; D.G. Hardin; M.S. Matthews. Technical Report A-84-3. February 1984. 24 pp.

Evaluation of methods for sampling vegetation and delineating wetlands transition zones in southern Louisiana, January 1979-May 1981. S.W. Fletcher. Technical Report Y-83-1. October 1983. 304 pp.

Effects of organic amendments to sediment on freshwater macrophyte growth. J.W. Barko; R.M. Smart; M.S. Hennington; D.G. McFarland; L.D. Ferguson. Technical Report A-83-5. October 1983. 32 pp..

Simulated mechanical control of aquatic plants in Buffalo Lake, Wisconsin. B.M. Sabol. Miscellaneous Paper A-83-8. October 1983. 49 pp.

White amur bibliography. C.R. Smith; J.V. Shireman. Miscellaneous Paper A-83-7. August 1983. 183 pp.

Large-scale operations management test of use of the white amur for control of problem aquatic plants. Reports 2 and 3. First and second year poststocking results. Volume 5. The herpetofauna of Lake Con-

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MEETINGS

27TH AQUATIC PLANT MANAGEMENT SOCIETY MEETING. July 12-15, 1987, Savannah, Georgia. For more information contact G. Douglas Pullman, Publicity Committee/APMS, The Dow Gardens, 1018 W. Main Street, Midland, Michigan 48640.

14TH CONFERENCE ON WETLAND RESTORATION AND CREATION. May 14-15, 1987, Tampa, Florida. For more information contact Fred Webb, Director of Economic Development, Hillsborough Community College, Plant City Campus, 1206 North Park Road, Plant City, Florida 33566.

WETLANDS CREATION AND RESTORATION. October 4-7, 1987, Washington, D.C. For information contact the National Wildlife Federation, 1412 Sixteenth Street N.W., Washington, D.C. 20036-2266. (202) 637-3746.

SYMPOSIUM ON THE ECOLOGY AND MANAGEMENT OF BREEDING WATERFOWL. August 18-22, 1987. Winnipeg, Manitoba, CANADA. For information or registration forms, contact: Delta Waterfowl & Wetlands Research Station, Rural Route ¬1, Portage la Prairie, Manitoba, CANADA R1N 3A1. (204) 239-1900.

ANNUAL SCIENTIFIC MEETING, FRESHWATER BIOLOGICAL ASSOCIATION. July 22, 1987. London, ENGLAND. For more information, contact Miss Pamela Parry, Freshwater Biological Association, Windermere Laboratory, The Ferry House, Ambleside, Cumbria LA22 OLP, ENGLAND.

NEW ARTICLES

The Aquatic Plant Information Retrieval System (APIRS) collects research about aquatic plants and makes the research known through this newsletter and through bibliographies. We provide hundreds of free "retrospective" and "current awareness" bibliographies to users of the system every year.

Here is a sampling of some recent articles of interest. For lists of articles on specific aquatic plant subjects, contact Aquatic Plant Information Retrieval System, 2183 McCarty Hall, University of Florida, Gainesville, Florida 32611. (904) 392- 1799.

Agami, M.; S. Beer; Y Waisel. 1986. The morphology and physiology of turions in Najas marina L. in Israel. Aquat. Bot. 26(3/4):371-376.

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Anderson, J.M.; S.C.H. Barrett. 1986. Pollen tube growth in tristylous Pontederia cordata (Pontederiaceae). Can. J. Bot. 64(11):2602-2607.

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Aulio, K. 1986. CAM-like photosynthesis in Littorella uniflora (L.) Aschers: the role of humidity. Annals of Botany 58(2):273-275.

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Bernasor, P.C.; S.K. DeDatta. 1986. Chemical and cultural control of bulrush (Scirpus maritimus L.) and annual weeds in lowland rice (Oryza sativa L.). Weed Research 26(4):233-244.

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RICE PRODUCTION REDUCED BY WEEDS

(From a seminar given at the Institute of Food and Agricultural Sciences, University of Florida, by visiting Fulbright Scholar Dr. Mashhor Mansor of Malaysia.)

Rice production in Malaysia is being seriously affected by aquatic weeds in irrigation and drainage systems and in the paddy fields themselves. Malaysians spend millions of dollars a year hiring teams of laborers to manually control aquatic weeds by cutting them with sickles and pulling them by hand. These efforts have not been effective.

The infestations are jeopardizing Malaysia's $500 million ($MS) investment in rice water control systems and are delaying the government's goal to make Malaysia a self-sufficient producer of rice, a staple food crop. In the past, rice yields in Malaysia have been as low as 0.80 t/ha. Experts say that with efficient water control and fertilizer use, rice yields could increase to 4.0 t/ha. Unfortunately, it is believed that leaching of fertilizer into canal systems enhances weed growth. Weed growth, in turn, makes water control extremely difficult, more difficult than many of us would have occasion to know.

Malaysia has more than 900,000 acres of wet paddies served by an intricate network of more than 10,000 km of irrigation and drainage canals. In the irrigation canals, obstruction by weeds greatly reduces water flow into paddy areas. Weeds also greatly reduce water availability through high rates of evapotranspiration. At the other end of the system, weed clogging of drainage canals causes periodic damaging flooding of the rice paddies. Partly as a result of irregular water control caused by aquatic weeds, farmers have abandoned many ricefields.

Studies by Dr. Mashhor Mansor of the University of Science Malaysia (Penang) have identified the aquatic weeds of Malaysia's ricefields and irrigation and drainage systems. Of 51 species identified, the four most serious weeds in the water-management systems are waterhyacinths (Eichhornia crassipes), hydrilla (Hydrilla verticillata), coontail (Ceratophyllum demersum) and Nymphoides indica. Waterhyacinths infest 80% of the canals in the country. Mansor found that in some instances waterhyacinths "completely blocked" water supply to ricefields. He also found that hydrilla and coontail impede water flow in drainage canals, causing high water level and periodic flooding, reducing rice yeild. Of those weeds in paddy fields, Scirpus grossus and Echnochloa crus-galli are major competitors with rice.

Dr. Mansor

Mansor recently won a Fulbright Scholarship. He chose to study at the IFAS Center for Aquatic Plants where he is now observing methods used in Florida to control waterhyacinths and hydrilla. When he has returned home, Mansor expects to make weed control recommendations to the rice section of MARDI, the Malaysian Agricultural Research and Development Institute.

In Florida, Mansor is studying herbicidal and biological control methods. He is especially interested in the use of grass carp for hydrilla control and weevils for waterhyacinth control.

SOME AQUATIC PLANT MANUALS

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(See MANUALS on page eleven...)

STONE LAB - OHIO STATE UNIVERSITY

Stone Lab is the oldest freshwater biological field station in the United States. It is located on Gibraltar Island at Put-in-Bay, Ohio. Since its origin in 1895, the Ohio State University station has provided research opportunities in aquatic, terrestrial and island sciences.

The purpose of Stone Lab is to offer a comprehensive review of freshwater systems and specific information on the unique environmental problems of Lake Erie. It provides courses to meet the needs of advanced undergraduate and graduate biological science majors, professional biologists and ecologists, and biology and general science teachers. Stone Lab is administered by the Center for Lake Erie Area Research (CLEAR), part of the College of Biological Sciences at the Ohio State University.

Stone Lab provides facilities for both classroom teaching and individual research. Course listings include classes in the fields of botany, entomology, environmental and marine biology, oceanography, zoology, and microbiology. Three summer terms of two and a half weeks each and one five-week term are offered at Stone Lab. The Lab library specializes in books, reprints and maps relating to aquatic environments. Three large boats are equipped for student field trips and research. High school and college science teachers are encouraged to bring students to Stone Lab for workshops or field studies in the spring and fall. Stone Lab can provide laboratories, boats, field equipment, and field ecologists for such groups.

In addition to a pleasant study and research environment, the location of the Lab offers access to many points of interest in the region, including blue holes, several hundred acres of wet prairie, stream environments and extensive marshes.

For additional information on Stone Lab, contact Stone Lab, College of Biological Sciences, The Ohio State University, 484 West 12th Avenue, Room 112, Columbus, Ohio 43210-1292, (614) 292-8949.

AN INTERACTIVE SYSTEM

Louis Carlos Lizama, a graduate student in the IFAS Animal Science Department, recently completed his MS Thesis, "Utilization of Aquatic Plants Elodea canadensis and Hydrilla verticillata in Diets for Laying Hens and Broilers," after spending considerable time at the Aquatic Plant Library. In exchange for the free use of our resources, Mr. Lizama presented us with a copy of his thesis for inclusion in the database, where it is now on file and available to users. We thank Carlos for his contribution and wish him luck as he returns to his native Guatemala.

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(See MANUALS on page thirteen...)

GRASS CARP STOCKING MODEL FOR COLD WATER LAKES

by E.P. Bergersen and E.D. Swanson, Colorado Cooperative Fish and Wildlife Research Unit, Colorado State University, Ft. Collins, Colorado 80523; (303) 491-6942.

Grass carp have proven their worth in this country as aquatic weed control agents in warm waters. Several stocking models have been developed to guide this activity under specific regional conditions. However, appropriate stocking guides have not been developed for cold water lakes. Indeed, the use of grass carp for vegetation control in cold water lakes has only recently been evaluated. To provide management guidelines for the use of grass carp in cold water trout lakes we developed a stocking model based on eight factors which would influence stocking densities and probable success of aquatic vegetation control measures using these fish. Factors include water temperature as a function of lake elevation, vegetation density and distribution, species composition, fish disturbance factors, management objectives for the lake, and the size and genetic make-up (ploidy) of the fish to be stocked.

Accumulated daily temperature units derived from 38 Colorado lakes at elevations from 1,127 m (3,700 ft) to 3,871 m (12,700 ft) were used to determine grass carp feeding activity rates as a function of lake elevation. Relative vegetation densities and distributions were based on field measurements in 6 typical Colorado trout lakes and observations at several others. Grass carp preference rankings for common aquatic plants in Colorado were derived from feeding trials and literature sources. A disturbance factor was added to the model to reflect the sensitivity of grass carp to human activity at or near their feeding areas. Model adjustments are made to accommodate lake management objectives, the size of available fish to be stocked and their genetic make-up (diploid fish being somewhat more efficient weed control agents than triploid fish).

The model emphasizes the important ecological role of aquatic vegetation. Stocking rates for sport fisheries are designed to "control", not eliminate, vegetation. Under these conditions, target control levels (15-25% vegetation distribution) will not be achieved until 3-4 years following grass carp introduction. This follows a grazing management approach where a balance is sought between plant removal and plant production over time and space. This approach emphasizes continuous cropping of vegetation to maintain an ecologically beneficial level while minimizing negative biological and recreational impacts.

Model output includes recommended stocking rates and the total number of fish to be stocked. A user manual is available as is a computer program designed to process stocking recommendations.

IPOMOEA FISTULOSA: A NEW PROBLEM FOR INDIA?

by Christopher D. Cook,
Botanischer Garten der
Universitat Zurich, Zollikerstrasse
107, CH-8008 Zurich, Switzerland.

When one visits sites at intervals of several years some changes are apparent that the local inhabitants have sometimes failed to notice. On a recent tour in India the enormous spread of Ipomoea fistulosa was immediately obvious to me but it does not seem to have caused any alarms. Locally on a small scale it is already a pest but, as far as I could find out, no coordinated work on its management or eradication is being carried out in India, or indeed elsewhere.

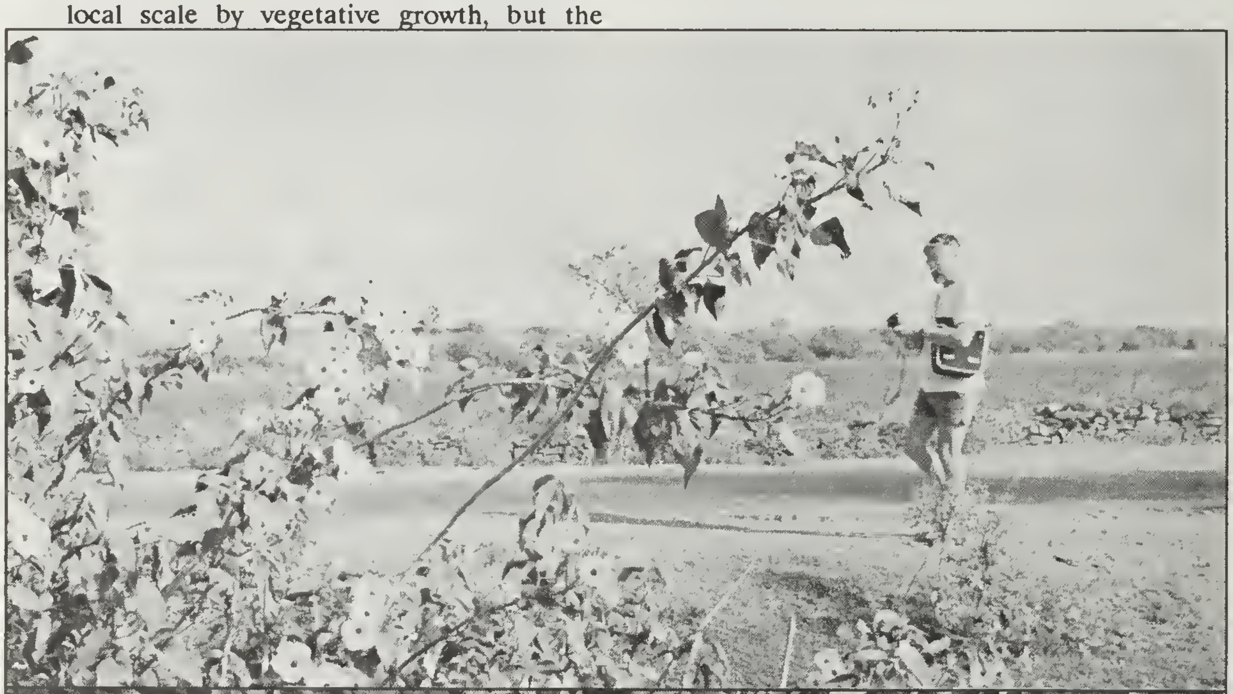
Ipomoea fistulosa Martius ex Choisy is sometimes called I. crassicaulis Bentham (a later synonym) or it is included within I. carnea Jacquemont where it is sometimes recognised at the rank of subspecies. For details see Austin (Taxon 26(2-3):235-238 1977). Ipomoea carnea in the strict sense is a twining climber, with heart-shaped leaves without hairs. Both are clearly related to each other but I prefer to recognise them at the rank of species.

I have had the opportunity to study I. fistulosa in the Pantanal in western Brazil and eastern Bolivia where it is native. It is very common on the silty Pantanal and apparently absent from the sandy regions. In the silty Pantanal along the River Paraquay it shows an enormous ecological amplitude being found on dry rocks, on the banks of rivers and lakes, in water up to about 2 m deep or as a component of floating islands. Under all these conditions the leaf-form remains very constant and I have never seen any trend towards a climbing habit even when the plant grows in shade. Under dry conditions it does not seem capable of tolerating much competition but in water or mud it is highly competitive. Under wet conditions the stems become inflated and may be as thick as a human arm. These inflated stems are hard and not spongy as one might expect. Also they are capable of rooting (Fig.2). In regions that are regularly flooded I. fistulosa is often dominant and forms stands of several hectares.

In India I have seen it around Delhi, in Uttar Pradesh, Rajasthan, Kernataka and Kerala. It is recorded in recent floristic works in most states of peninsula India. It is apparently lacking in the northern regions and is not known above 1000 m. Under the name I. carnea it has been cultivated in India since the beginning of this century. However, I have not been able to check whether this early introduction was I. carnea in the strict sense or whether it is I. fistulosa. Both are attractive plants with large rose-purple corollas. It is only in the last 10 to 15 years that the presence of I. fistulosa outside cultivation has been noticed in India.

It is not eaten by livestock (ducks, goats, cattle, buffalo elephants, etc.) and is easily propagated by stem cuttings and withstands periods of flooding and desiccation. It makes an ideal living fence and is easier to manage than the common alternatives: upright cacti succulent euphorbias or thorny species of Acacia and Prosopis.

It is likely that the original spread is due to its suitability for making living fences. However, as soon as it gets into seasonally inundated land or irrigation or drainage ditches and canals it is capable of spreading rapidly. The spread is presumably on a local scale by vegetative growth, but the fruit-set is very good and spread by seed is probably also important but I have no direct evidence.



In the Chambal Project (Rajasthan, India), an irrigation scheme of about 565,000 ha. opened in November 1960. I. fistulosa was first noticed about ten years ago and now occupies an area of about 600 ha. according to Mrs. Indu Mehta. Many drainage ditches are already blocked It can be killed by applying 2,4-D at 3 kg/ha with a sticking agent. The dead woody bases must however, be removed from ditches and canals by hand, if it does not get dry enough to burn them.

If I. fistulosa is left to spread in aquatic ecosystems in India it could build up very large populations as it does in tropical South America. Eradication or control of small populations is relatively easy but eradication of very large populations is another matter, it is not only expensive but dangerous.

Fig.1 *Ipomoea fistulosa* growing in a drainage ditch near Kota, Rajasthan, India.

Fig.2 *Ipomoea fistulosa* showing rooting stems.

WEST INDIES LABORATORY
Main laboratory building and aquaria area. Large circular tanks contain seawater pumped from Tague Bay and fed by gravity through the seawater system.

WEST INDIES LABORATORY

FARLEIGH DICKINSON UNIVERSITY. St. Croix, U.S. Virgin Islands

The West Indies Laboratory (WIL) is a marine science teaching and research facility operated by Fairleigh Dickinson University of New Jersey. Built in 1971, WIL occupies an 8-acre campus on the northeastern shore of St. Croix in the U.S. Virgin Islands, facing Tague Bay and the Buck Island Reef National Monument.

The purpose of the laboratory is to conduct a year-round teaching program in marine science for undergraduate and graduate students, to perform research, and to assist the local government and the Caribbean region in the application of research to problems of marine resource management and development.

The staff of WIL includes leaders in tropical marine research with expertise in marine biology, ecology and geology. Contributions to the scientific literature total almost 200 research papers authored by WIL faculty, visiting investigators and students.

Facilities at WIL include large classrooms and laboratories, a controlled environment room, an analytical laboratory with a narrow beam spectrophotometer and fluorometer, and a light microscopy laboratory. Attached to the facility is a large flow-through seawater aquaria patio which offers great flexibility for experiments and observations. A separate geology wing has facilities for geochemistry, petrography, sediment and core analyses and x-radiography.

The WIL library houses a collection of books and periodicals on Caribbean flora, fauna and geology. Computers are available for data and word processing.

WIL is convenient to snorkeling and scuba diving, and maintains a modern diving facility with equipment, boats and a qualified diving supervisor.

From 1978 to 1985, WIL operated the diving facility, Hydrolab, owned by NOAA. Hydrolab allowed unlimited scuba bottom time at depths less than 100 feet and served over 400 scientists on more than 60 scientific diving missions before being retired as a permanent exhibit to the Smithsonian Institution. WIL is now constructing a new NOAA diving facility which will become available in 1988 to serve the National Undersea Research Program.

Additional information about WIL and its fees to visiting researchers may be obtained by writing, **Dr. John C. Ogden, Director,** West Indies Laboratory, Tague Bay, Christiansted, St. Croix, U.S. Virgin Islands 00820, USA

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LYNGBYA PHYSIOLOGY RESEARCH

A little-known aquatic plant is suddenly multiplying rapidly in the southeastern United States and researchers are finding that its control will not be simple. It is a filamentous mat-forming blue-green alga which is resistant to aquatic herbicides. The plant especially prefers waterbodies of high pH previously infested with other submersed plants. If the plant infestation is removed, decreased competition enables the alga to proliferate. Eventually the mats of thread-like plants rise to the surface where they become thick and heavy. Recently, filamentous algae coverage throughout Florida increased by 62% in only one year.

The alga, a species of Lyngbya (probably L. bergei), has been studied by Dr. George Bowes, Dr. Sven Beer and Mr. William Spencer for the past two years. Bowes and Spencer are University of Florida botanists. Beer is a visiting scientist from Tel Aviv University, Israel.

The identification of this species of Lyngbya is tentative. There is speculation that it is a marine species tolerant to low salinity levels that has become established in fresh water. The researchers found very little information in the literature about the ecology and physiology of filamentous algae, and so devised experiments to learn more about the competitive characteristics of Lyngbya. They have studied the photosynthesis, effects of climate on growth, biomass production and nutritional biology of Lyngbya. They have found that Lyngbya can thrive in waters inimical to growth of other aquatic plants, and that it behaves photosynthetically much like another efficient plant, hydrilla.

In their studies, Bowes, Beer and Spencer discovered that Lyngbya grows exceedingly well in waters having very high pH levels; levels as high as pH 10.5 can be found in floating mats. They discovered that Lyngbya can use bicarbonate as its sole carbon source, whereas most plant photosynthesis utilizes carbon dioxide. The alga is therefore able to grow in water of high pH which is depleted of carbon dioxide but does contain bicarbonate. Beer says Lyngbya is the most efficient bicarbonate user among macrophytes he has seen.

The scientists also have found that Lyngbya responds very well to high temperatures (it photosynthesizes well at 40 degrees C) and low light levels (it grows at levels as low as 1% full sunlight), and is insensitive to oxygen (which in other plants reduces photosynthetic rates by increasing photorespiration).

Lyngbya is present in many of the study lakes, growing in small amounts near the bottom of the water column and sometimes in the sediment as well. When conditions improve, Lyngbya grows luxuriantly and oxygen bubbles produced by photosynthesis are caught within the algal filaments. As the oxygen accumulates, the plant tangles become bouyant and eventually rise to the surface where they continue to grow and form very thick mats. Lyngbya can form mats which weigh up to 12 kilograms (fresh-weight)/square meter (120 tons/ha), which is even more than hydrilla.

Dr. Sven Beer (left) and Mr. William Spencer. Beer, of Tel Aviv University (Israel), is about to end his two-year research sabbatical as a visiting scientist to the Photosynthesis Research Laboratory of Dr. George Bowes, University of Florida Department of Botany. Beer, an expert on carbon fixation and photosynthesis of aquatic plants, was invited to Florida to conduct research on the alga, Lyngbya. The little understood plant is spreading throughout Florida and the southeastern United States, covering lakes with thick noxious mats. The work of Beer and Spencer has resulted in a substantial body of knowledge about the physiology of Lyngbya.

In balanced systems when other submersed plants are present, Lyngbya is forced to compete for light, carbon dioxide and other nutrients and remains "just another plant." However, when all other submersed plants are removed, conditions often favor Lyngbya growth. Once established, the Lyngbya mat becomes so dense that the regrowth of other submersed vegetation is inhibited and Lyngbya remains the predominant plant.

Possibly the best control for Lyngbya is the maintenance of other more desirable submersed vegetation. Where Lyngbya is present, care must be taken not to completely eliminate other aquatic plants.

Plant competition studies have begun under Bowes, Beer and Spencer. In these experiments, Lyngbya, hydrilla and native aquatic plant species, with and without herbicides, are being investigated. The researchers expect these preliminary trials to assist in devising large-scale experiments for the practical control of Lyngbya.

This work is funded by the Florida Department of Natural Resources, Bureau of Aquatic Plant Management, and the IFAS Center for Aquatic Plants.

Bowes, Beer and Spencer may be contacted at the Photosynthesis Research Laboratory, Department of Botany, 3157 McCarty Hall, University of Florida, Gainesville, Florida 32611; (904) 392-1891.

LYNGBYA BIOCONTROL RESEARCH

Many lakes in Florida, such as Okeechobee and Apopka, have historically suffered from algal blooms. However, "blooms may be more frequent now and perhaps more severe as eutrophication proceeds," says Dr. Edward J. Phlips, a biologist in the IFAS Department of Fisheries and Aquaculture. Phlips has specialized in the mass culture of marine and freshwater algae.

Phlips is now studying the use of viruses as a biological control for the blue-green algae, Lyngbya, and eventually other species of algae as well. Lyngbya forms malodorous, possibly- toxic floating mats when conditions are right. Phlips believes that viruses may be valuable biological controls because they are more host-specific than herbicides or fish. And, according to Phlips, Florida's year-round growing season may offer an ideal environment for viral algae control projects.

The goal of Phlips' new two-year study is to evaluate the potential of viruses to control blooms of Lyngbya which plague lakes and ponds in Florida. The study is comprised of three parts: 1) tests of known "LPP" viruses on Lyngbya; 2) survey of local viruses for activity against Lyngbya; and 3) field tests of selected viruses on Florida lakes having Lyngbya blooms.)

(See LYNGBYA on page sixteen...)

REVEGETATION PROJECTS IN ORLANDO LAKES

by ROGER M. COX, City of Orlando, 1010 South Westmoreland Drive, Orlando, Florida 32805

It all started in the winter of 1984 with 400 cypress trees. Sounds like Grand-Dad reminiscing about the "good ol' days," but that was when our successful transplanting program began to grow. We began "aquascaping" The City Beautiful.

I am the Aquatic Plant Control Supervisor in the Storm Water Management Section of the Bureau of Streets and Drainage in the city of Orlando. Orlando has had an aquatic plant control program for about 25 years. Among other repsonsibilities, this bureau manages aquatic plants in 45 sovereign lakes of the 77 within the city limits. The 32 remaining lakes are privately owned by homeowners or associations.

In 1983, the Orlando City Council ordered an overall clean-up of our lake shorelines. The shorelines were dominated by vegetation including water primrose (Ludwigia octovalis), cattail (Typha spp.), alligatorweed (Alternanthera philoxeroides) and torpedo grass (Panicum repens). These plants were limiting shoreline access and prohibiting the expansion of more desirable aquatic macrophytes. Hydrilla (Hydrilla verticillata) and waterhyacinths (Eichhornia crassipes) were under maintenance control when the clean-up project was begun. Because these major pest plants were under maintenance control we had more time to concentrate on selective management of shoreline plants.

It was during the shoreline clean-up project that our aquascaping concepts were born. In Orlando, four or five lakes contain old stands of majestic cypress trees. Because of their beauty and shade, I decided to try transplanting some smaller trees from the outer swampy areas of the city to see what would happen. During the winter months of 1984, five crew members and I hand-dug 400 bald cypress trees and transplanted them into the shallow margins of seventeen lakes. We used the bare root method to transplant these trees which ranged in size from 4 to 15 feet. To my surprise and delight, the trees had a 90% survival rate.

Community response to our efforts was remarkable. Many people stopped and talked with us and a few wrote appreciative letters to our office. One citizen was so pleased with the transplantings that he wrote a letter to Mayor of Orlando Bill Frederick, complimenting our efforts to reestablish cypress trees.

Due to the positive response from the public, we continued the transplanting program. We worked mainly with cypress trees in 1984 but also transplanted giant bulrush (Scirpus californicus) into eight lakes, and pickerelweed (Pontederia lanceolata) and arrowhead (Sagittaria latifolia) into one lake. Their survival and expansion rate was very good in 1984.

Most of this work is accomplished during the winter months when dormancy of the trees and plants decreases the shock of transplantation. Also, with winter being the non-growing season, I am able to reassign crews from control work to transplanting work.

In 1985, transplanting stock for plants and trees was still being collected from outlying swamps and canals. Six hundred cypress trees were hand-dug and transplanted to 25 lakes, and experienced a 90%-plus survival rate. Extensive transplanting of pickerelweed and giant bulrush was begun. Maidencane (Panicum hemitomon), knot-grass (Paspalidium geminatum), fuirena (Fuirena scirpoides), golden canna (Canna flaccida), and soft rush (Juncus effusus) were included in our program in 1985 with great success.

In 1986, additional monies were appropriated for the purchase of bald cypress and loblolly bay saplings. In October of that year, 2,000 three- foot and 1,000 ten-inch bay saplings were planted around nine lakes. In January 1987, monies were still available to purchase 2,000 bald cypress trees. These trees were in 3-gallon containers and ranged from 4 to 6 feet in height. The trees were planted in January around 34 lakes and have started to flourish. It is now the latter part of March 1987 and I expect a survival rate in the high 90% range. In addition, one hundred fifty palmetto plants were hand-dug, planted in 3 gallon containers and stored at the city nursery. All the outer fronds died back within two weeks of transplanting, but about 75% of the buds are still green. Some sprouting from the base of the plants may occur later. In early February 1987, 484 loblolly bay trees were hand dug and transplanted around 2 lakes. These trees ranged from 4 to 12 feet in height. They appear to be living, with approximately half showing evidence of budding. It is still too early to predict a survival rate.

Expected benefits from all this work are numerous. Macrophytes that improve fisheries habitat are giant bulrush, maidencane and knot-grass; for bird habitat: cypresss trees, bay trees and giant bulrush; for waterfowl habitat: maidencane, knot-grass, giant bulrush, fuirena, golden canna, pickerelweed, arrowhead and palmettos. Tannic acid from cypress trees could be a natural coloring to shade-out some species of algae. Shade from the cypress trees and plants also could reduce algae growth. Nutrient uptake through plant growth may improve water quality.

In summary, the total ecosystem will benefit from the transplantation work we have begun. Other important beneficiaries are the residents and visitors of Orlando. Aesthetics are very important to Orlandoans and we try very hard to live up to our logo: "The City Beautiful."

(I express my thanks to the Army Corps of Engineers Aquatic Plant Control Section, Palatka; Department of Transportation Orlando Maintenance Department; the Greater Orlando Aviation Authority; and the Orange County Environmental Protection Department for allowing us to obtain trees and macrophytes for transplanting. Special thanks go to my hard working crews who have shown pride and professionalism in the quality work they have accomplished.)

AQUAPHYTE

AQUAPHYTE is the newsletter of the Center for Aquatic Plants and the Information Retrieval System of the University of Florida Institute of Food and Agricultural Sciences (IFAS). Support for the information system is provided by the Florida Department of Natural Resources and by the U.S. Army Corps of Engineers Waterways Experiment Station Aquatic Plant Control Research Program (APCRP).

EDITOR: Victor Ramey

AQUAPHYTE's is sent to 3,000 U.S. and Canadian biologists and agencies. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.

We gladly permit free republication of AQUAPHYTE items when accompanied by full acknowledgement.

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AQUATIC PLANTS AND NEMATODES

Nematodes which are parasitic to aquatic plants may have potential to serve as biological control agents for aquatic weeds. Recently, a comprehensive two-year survey of plant- parasitic nematodes in north Florida lakes was completed by Dr. Grover C. Smart, Jr., Dr. Karin Gerber and Mr. Robert J. Cox of the IFAS Department of Entomology and Nematology. Their work was funded through the Cooperative Agreement between the U.S. Department of Agriculture's Agricultural Research Service and the IFAS Center for Aquatic Plants.

The researchers sampled freshwater aquatic plants and sediments for plant-parasitic nematodes, examined aquatic plants for damage caused by nematodes, propagated nematodes for laboratory tests, and tested pathogenicity of nematodes to certain aquatic plants.

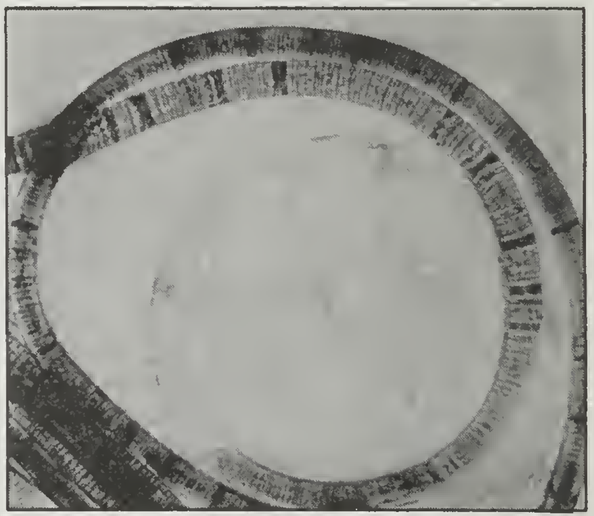
Twenty-five species of plant-parasitic nematodes were found to be associated with 35 of the 63 aquatic plant species studied. The most frequently sampled plant species were Ceratophyllum demersum, Hydrilla verticillata, Vallisneria americana and Sagittaria lancifolia. The most frequently found plant-parasitic nematodes were Hirschmanniella caudacrena, which infested 9 species of aquatic plants; Aphelenchoides fragariae, which damaged Hydrilla apical buds and plant tissue of other plants; and Helicotylenchus spp. All life-stages, including eggs, of Aphelenchoides were found in infested Hydrilla buds. High nematode densities were found consistently only on C. demersum.

Part of the study determined the pathogenicity of Hirschmanniella caudacrena to Ceratophyllum demersum and Hydrilla verticillata. Inoculum densities of 500 nematodes resulted in death and decay of growing plant fragments of C. demersum at 8 weeks, 100 nematodes killed the fragments at 12 weeks, and lower inoculum levels of 25 to 50 nematodes killed them by 16 weeks.

Nematode-infested plants showed discoloration. Infested Ceratophyllum plants in the field exhibit a yellow-green to orange-brown discoloration of the whole plant, except for the apex. Nematodes in Ceratophyllum occur in the aerenchyma. Hydrilla did not show nematode symptoms in the field.

The study also showed a tendency for nematode populations to increase in the spring and late fall, and to decline during the hot summer months of July, August and September.

Nematodes as Biological Agents for Aquatic Weeds. 1986. Grover C. Smart, Jr., Karin Gerber, and Robert J. Cox, IFAS Department of Entomolgoy and Nematology, Nematology Lab, Building 78, IFAS, University of Florida, Gainesville, Florida 32611.



Lyngbya bergei, a filamentous blue-green alga. Photorespiration of Lyngbya remains low throughout the year without significant C4 photosynthetic metabolism, and carbon acquisition is efficient.

Phlips is sampling lakes in Florida to find viruses which occur in eutrophic waters. In viral assays so far, his group has found three viruses which act against blue-green algae, but not Lyngbya. Further steps Phlips will take to develop viral controls include isolating the virus, determining the virulence and longevity against algae, large-scale laboratory testing of algae cultures to determine dosage rates and longevity of effects, selection of test sites and acquisition of approval for lake trials.

In controlled studies, Phlips is mass culturing Lyngbya and inoculating the mats with the host-specific virus. The virus is then encouraged to multiply before being extracted with chloroform and freeze-dried for storage (which does not harm the virus). Later, the virus will be incorporated into various formulations which make it possible to evenly distribute the pathogen over large areas. Then, the best sizes of control areas and frequency of treatments can be determined.

The virus works by infecting the cells, replicating and erupting, thus releasing the virus. Lysis (cell eruption) takes only days to occur. In this way, the virus spreads and "kills the algae." It is thought that the best time to treat Lyngbya is at the first signs of bloom, especially in spring.

Basic research on the viral control of algae is expected to take from 2-5 years. Formulation development of the inoculum and potential commercial products will take additional time for testing and registration.

In other work, Phlips has isolated and is culturing over 20 species of algae found in blooms in Lakes Okeechobee, Apopka, Orange and Lochloosa. He is experimenting with the possibility of commercial products from blue-green algae, such as polymers which are excreted by several species, and nitrogen fixation additives for soils from other algal species.

Phlips receives funding from a USDA-ARS Cooperative Agreement, through the IFAS Center for Aquatic Plants. He is located at the Department of Fisheries and Aquaculture, 7922 N.W. 71st Street, University of Florida, Gainesville, Florida 32606, (904)392-9613.

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A Q U A P H Y T E

CENTER FOR AQUATIC PLANTS
Institute Of Food And Agricultural Sciences
University Of Florida

With Support From
The Florida Department of Natural Resources
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D.N.R.D.R.M.B.A.P.M.

This article is the second of a two-part series about the agencies which help fund the operation of the IFAS Center for Aquatic Plants' Aquatic Plant Information Retrieval System (APIRS).

APIRS is a technology-transfer system with a database of more than 25,000 books and reports about aquatic plant biology, ecology, control and utilization. APIRS provides information services, computer-generated "retrospective" and "current awareness" bibliographies of the literature, and reprints, to more than 500 aquatic plant researchers and managers, and provides AQUAPHYTE to more than 4,000. These services are provided free of charge.

The Florida Department of Natural Resources and the U.S. Army Corps of Engineers Aquatic Plant Control Research Program fund APIRS for users in the U.S. and Canada. (Provision of these services to other countries remains suspended until funding to pay the production and mailing costs for overseas clients is obtained.)

The article which examined the Corps' Aquatic Plant Control Research Program appeared in the last issue of AQUAPHYTE.

"Where have all the bureaucrats gone?" I asked the secretary. I had visited the Bureau to see what they do. I found all their offices empty. No wonder aquatic weeds are taking over, I thought; those in charge are always on coffee break.

"They're all on Lake Okeechobee," she answered. (They drove 300 miles to take a coffee break?) "They're surveying and mapping the vegetation of the lake." No wonder aquatic weed management in Florida is so successful, I thought; even the paper-pushers are enlisted to do real work; even the paper-pushers know aquatic weed problems first hand.

The **Bureau of Aquatic Plant Management** of the Division of Resource Management of the Florida Department of Natural Resources is a small office with a big job. It regulates aquatic plant management in Florida.

Applying dye to canals.

The Bureau promulgates rules and initiates legislation, issues permits, monitors work, methods and results, disburses millions of tax dollars to water management districts, counties, cities and local taxing districts, conducts in-house research and contracts research work with others, and answers questions and gives advice to thousands of homeowners, companies, associations and agricultural, recreational and environmental interests every year.

The Bureau has three sections: **Aquatic Plant Regulation, Research and Technical Services; Survey and Control Permitting;** and **Contracts and Grants.** The Bureau's main office is in Tallahassee, but it maintains six regional biologist field offices throughout Florida.

The Chief

Ms. Shirley Fox is Bureau Chief. Experienced in management and environmental planning, she was appointed to the post only two years ago. "At first, I didn't realize the impact of aquatic plants on Florida's economy and the quality of life of its residents. I

[See BUREAU on page 4]

TIDES AND HERBICIDES

Herbicidal control of *Hydrilla* in freshwater tidal areas, and in other flowing waters, may be far more efficient in the near future thanks to experiments now taking place.

Drs. Alison Fox and William Haller hope to determine the optimal tidal time for herbicide application in order to maximize contact with the target plant, thus making herbicidal management of submersed weeds in tidal areas more predictable and efficient and less expensive. Results of these studies will be applicable up and down the United States eastern seaboard where hydrilla is becoming a problem in tidal areas. These studies also will be consequential to the management of hydrilla in other flowing water situations.

Very little is known about herbicidal control in tidal situations. Currently, hydrilla management in tidal areas is often ineffective because the flushing rates of such systems dilute and disperse aquatic herbicides before the necessary contact time for control has been achieved. These experiments will

[See TIDES on page 11]

SWIM BILL ENACTED

Florida's **Surface Water Improvement and Management Act (SWIM)** was signed into law on June 29 by Governor Bob Martinez. The bill affects aquatic plant management in that aquatic weed status is one criteria by which water bodies are being prioritized, and aquatic plant management strategies are included in the bill as means of cleaning up or restoring water bodies.

The law calls for six major Florida water bodies to be studied and cleaned up: Lake Okeechobee, Lake Apopka, the Indian River, the St. Johns River, Biscayne Bay and Tampa Bay. The SWIM programs will be administered by the Florida Department of Environmental Regulation and the five regional water management districts. Initial state appropriations for the first year are about $15 million.

A priority list will be made of water bodies of "regional or statewide significance" based on criteria such as water quality, nutrient loads, aquatic weed status, biological status, fish and wildlife values and threats to water supplies or recreation. Plans and schedules will be devised which will describe the history and uses of the water bodies, jurisdictions, adjacent land uses, sources of water pollution, strategies for restoring and maintaining acceptable water quality, and estimate costs.

At least one hearing for local input is required before plans are completed for each water body. Plans will be reviewed and funding proposals developed annually by the water management districts.

FUNDS ALLOCATED

Initial funding allocations were:

- $4.8 million for the South Florida Water Management District for Lake Okeechobee. An additional $2 million was appropriated for Biscayne Bay, with $500,000 targeted for the Miami River and $1.5 million for stormwater retrofitting.
- $1.5 million for Indian River Lagoon.
- $2 million for the Southwest Florida Water Management District for Tampa Bay and its estuaries.
- $2.2 million and $2.5 million for the St. Johns Water Management District for Lake Apopka and the Lower St. Johns River.

LAKE OKEECHOBEE

The bill contains a separate section for Lake Okeechobee which specifies that the lake restoration program be based on recommendations of the Lake Okeechobee Technical Advisory Council **(LOTAC)**. The council must report its recommendations to the Legislature by March 1, 1988. Programs are to result in reduced phosphorus loadings to the lake by July 1991, allowing no harmful diversions to the Indian River estuary, the Caloosahatchee River or its estuary or the Everglades National Park.

ANOTHER RESOURCE FOR MANAGERS

Restoration & Management Notes is a magazine of notes, abstracts and articles about "restoration and wise stewardship of plant and animal communities" in terrestrial and aquatic situations. This magazine would be of interest to those involved in aquatic resource management; the Summer 1987 issue has no less than 12 notes and articles having to do with wetland, lake and river restoration and aquatic plant culturing and transplantation projects. This issue also includes a balanced article on the Kissimmee River channelization project and the current work to undo the project and restore the river to its natural condition.

R&MN is edited by William R. Jordan III and is published twice a year by the University of Wisconsin Press. Annual subscription costs are $13 for individuals and $28 for institutions. For subscription information, contact **Journals Division, 114 N. Murray Street, Madison, Wisconsin 53715.**

OKEECHOBEE'S BIG ALGA BLOOM OF 1986

"It would be ironic if the recent progress made in controlling nutrient loadings to Lake Okeechobee were responsible . . . for a major floating alga bloom last summer, but such a conclusion is at least plausible," according to a report by scientists advising the South Florida Water Management District.

P.L. Brezonik, J. Shapiro and E. Swain of the University of Minnesota postulate that the controversial bloom was due to the low nitrogen/phosphorus ratio in the lake, created primarily "because control of phosphorus inputs has been relatively less effective than control of nitrogen inputs." The low N/P ratio produced a shift in algae dominance to the heterocystous (nitrogen fixing) *Anabaena circinalis*.

The researchers say *Anabaena circinalis* can fix its own nitrogen so it is especially able to take advantage of low levels of inorganic nitrogen, thereby dominating other algal species. They contend that many researchers have shown that low N/P ratios cause blue-green algae to predominate.

Records show that since 1973 in Lake Okeechobee, N/P ratios have decreased significantly. Nutrient control methods such as diversion of "back-pumped" water from the surrounding land further reduces the N/P ratio. In 1985-86, for example, "nitrogen loadings decreased much more (almost by half) than phosphorus loadings."

The authors believe that further field studies must be done to verify this postulate before potentially expensive management measures are attempted.

CONTROLLED BACKPUMPING

If further studies support the idea that the N/P ratio is too low, the authors suggest that the District might resume "controlled" backpumping into the lake in order to increase the N/P ratio of nutrient inputs and thus the N/P ratio of the lake water.

They stress that controlled backpumping would be merely an "interim measure to restore a more balanced N/P ratio in the lake while other efforts continue to reduce total loads of N and P to the lake."

AT THE CENTER

MAJOR PUBLIC EDUCATION EFFORT TO BEGIN

The IFAS Center for Aquatic Plants should be the single agency to develop a "concerted, coordinated public education effort" about aquatic plant management in Florida. This agreement in principle has been reached by Ms. Shirley Fox, Chief of the Florida Department of Natural Resources Bureau of Aquatic Plant Management and Dr. Joe Joyce, Director of the Center for Aquatic Plants.

Instead of each of many federal, state and local agencies preparing programs and materials for public education, the Center would be the single agency to do so. Fox points out that "this will save money in the long run."

There is a special need for public education in Florida because of its high proportion of new residents who are unfamiliar with "aquatic weed" history and problems. Many of Florida's new residents are surprised and concerned by the state's naturally eutrophic waterbodies, and usually do not know the differences between Florida's native plants and the exotics which are displacing them.

This high proportion of new residents brings new homeowners, environmentalists, legislators, news reporters, fishermen and agency board members who have never seen a river completely covered with waterhyacinths, and who do not know how quickly infestations would occur were it not for "maintenance control".

Frequently, these new residents see managers dealing with small patches of waterhyacinths or hydrilla; they often believe that money is being spent unnecessarily, and that herbicides and machines are being used without need. As Joyce has put it, "Maintenance control is its own worst enemy."

Plans for the new public education effort will be presented to the Legislature by DNR and the Center by summer of 1988.

DIQUAT RE-REGISTRATION. Diquat disappearance field studies have been completed by Center personnel and samples have been delivered to Chevron Chemical Company for analysis. Mr. Francois Laroche takes sediment samples from a study pond. Chevron chemist Glenn Fujie observes sampling procedures.

AQUATIC APPLICATOR TRAINING MANUAL

A new aquatic pesticide applicator training manual is nearing completion. Dr. Ken Langeland is editor.

The manual will be used to help train applicators and supervisors in Florida and will be the primary study-guide for the Florida aquatic pesticide applicator's examination. For more information, contact Langeland at the Center.

HYDRILLA SEDIMENTATION STUDIES

Studies are underway to determine the contribution of hydrilla to sedimentation. The study is being conducted by Dr. Joe Joyce.

In previous studies, Joyce has shown that waterhyacinths contribute substantially to sedimentation, greatly increasing the rate at which waterbody depth is reduced and lakes become marshes.

AQUATIC PLANT SLIDE SHOW AVAILABLE

A slide show designed for public education about aquatic plant management is now available. The show was put together by Mr. Dan Thayer, with the help of the Center for Aquatic Plants and the Florida Aquatic Plant Management Society.

The show is available for the cost of reproduction and mailing. For more information, contact Thayer at the Center.

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Dr. Joseph Joyce, Director

BUREAU [From page 1]

have found that the problems are bigger, environmentally and economically, than I had ever imagined."

A mere $14 million a year is spent to keep aquatic weeds from choking Florida's public water resources worth billions.

More than 32 million people a year enjoy water-related recreation in Florida, having a major impact on the state's economy. For example, more than $250 million a year is spent on freshwater fishing alone. Much of the state's drinking water and agricultural irrigation water also is drawn directly from the state's lakes and rivers. Weeds very effectively interfere with all water recreation in Florida, shut down water intakes and greatly reduce water flow in water management systems.

Investment Protection

To protect these multi-billion dollar public resources, $14 million in federal, state and local tax dollars are spent for aquatic plant management in public waters each year. (Estimates are that private interests spend approximately the same amount for weed control in private waters.)

Help or Hindrance?

A state task force (the Environmental Efficiency Study Commission) may soon recommend that water resource permitting, which may include some of the Bureau's aquatic plant management permitting responsibilities, be delegated among the five water management districts. Bureau Chief Fox believes this fragmented approach could result in needlessly confusing permitting procedures and create inter-agency fights for funds, resulting in inequitable funding and inadequate control throughout the state. Aquatic plant control could become even more "political" than it is now.

Fox believes that in order to manage these problems effectively, her central Bureau is needed to monitor weed problems statewide and to apply the limited resources and funds fairly. If aquatic plant management permitting responsibilities are shifted, water management districts would have to establish separate permitting offices, bypassing the experience, consistency and procedures already in place at the Bureau. Furthermore, permits currently being considered by the Bureau are sent to several other state and federal agencies for review. Fragmenting the process among five agencies would increase paperwork and paperflow among all the agencies, likely resulting in permitting delays not now experienced.

Bureau Chief Shirley Fox

Streamlining

A major complaint of the Bureau in years past has been the time-consuming complexity of obtaining permits for aquatic plant management. Since assuming her office, Fox has worked to resolve this admitted problem. Under her direction, permitting has been consolidated into one Bureau section, cost-sharing contracts have been streamlined from 14 pages to 4, and work records have been computerized. The Bureau also is establishing a computerized system to link the six field offices with the Tallahassee office.

Major Projects

Fox also has begun major projects which are expected to make the permitting, monitoring and enforcement systems already in place more effective. In addition to the annual statewide aquatic plant surveys, the Bureau has begun detailed vegetation mapping of the state's waters which have "regional or statewide significance", such as the 1000 square mile Lake Okeechobee. This information will be used to help government agencies establish required annual aquatic plant management work plans, and is used by the Bureau to verify permitting needs.

In 1988, the Bureau will begin a "tank sampling" program in which random samples of applicators' herbicide tanks will be analyzed to verify their contents.

In addition, set-back requirements for herbicide treatment near potable water intakes will be established for individual situations, after research is completed.

SURVEY AND CONTROL PERMITTING SECTION

Aquatic plant permitting is delegated to the Bureau by the Florida Department of Environmental Regulation (FSS 403.088; DER permitting). The Bureau issues permits and investigates misuse; DER prosecutes violations.

Mr. Jeff Schardt and the eight regional biologists in his section, process more than 1,000 mechanical, herbicidal and drawdown aquatic plant control permits each year.

Regional biologists receive permit applications and personally document the management needs and methods by identifying plants and problems, and making management recommendations. In 1986, section personnel participated in more than 22,000 consultations.

According to Schardt, approximately 80% of the management permits issued are for herbicidal control, 10-15% for mechanical control, and the remainder are issued for drawdowns.

Only one-third of the state's hydrilla is treated each year. Each year more hydrilla is present throughout Florida.

The most commonly issued permits are for control of the exotic plants waterhyacinths and water lettuce. Hydrilla is the second most frequently controlled. The third most common permits are for controlling aquatic grasses such as torpedo grass, and filamentous algae control permits are the fourth.

Monitoring and Enforcement - Violators Beware!

Each week, randomly chosen field sites are visited by regional biologists to verify that work is being done according to permit and label restrictions. Viola-

[See BUREAU on page 5]

BUREAU [From page 4]

tion of a permit rule is punishable by a maximum fine of $500. Misuse of herbicides is punishable by a maximum fine of $10,000 per site per day. In the past several years, some violators have been caught and several $5,000 fines levied.

Annual Aquatic Plant Surveys

Schardt says that one of the most important functions of the permitting section is the annual survey of 500 water bodies throughout the state. One and a half million acres of lakes, rivers and canal systems, having boat ramps or major public access, are surveyed between April and October. "We determine plant coverage and species diversity to assess the success of control programs and to prevent problems before they occur." Of the 160 species identified in the surveys, only 10 account for more than half the aquatic plant coverage of the state. Four of these ten species are exotic.

Costs

The Bureau calculated that 60,000 acres of hydrilla were present in the water bodies surveyed in 1986. That year control permits were issued for only 20,000 acres of hydrilla, costing $3 million.

The 1986 survey showed 7,000 acres of waterhyacinth were present. However control permits were issued for 25,000 acres, costing $2 million. Many more acres were controlled than were present at one time because of the rapid regrowth of waterhyacinths during one season.

Waterhyacinth Success

Schardt says citizens should be pleased with the state-wide success of waterhyacinth management. In 1983, control permits were issued for 46,000 acres of waterhyacinth (almost twice the acreage of 1986) at a cost of $5 million. He attributes the successful reduction of the waterhyacinth problem to "maintenance control", the consistent and continuous control of the plant to prevent re-infestation. Schardt claims that maintenance control, encouraged statewide through the permitting section, has resulted in less management costs, less use of herbicides and less destruction by waterhyacinths of stands of native plants which are beneficial to fish and birds.

BUREAU OF AQUATIC PLANT MANAGEMENT

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Mr. Greg Jubinsky

CONTRACTS AND GRANTS SECTION

Many local and regional government agencies which manage aquatic plants qualify for state and federal cost-sharing. The Contracts and Grants Section of the Bureau is responsible for contracting with these agencies and for allocating the available funds among them. **Mr. Greg Jubinsky** is the section administrator.

The section manages almost 100 contracts with counties, water management districts and special taxing districts, based on annual work plans submitted to the Bureau by the "cooperators". The work plans must reflect the requirements of the Bureau and the U.S. Army Corps of Engineers.

The contracts and grants section manages two funding programs: the **cooperative program** between the Army Corps and DNR, and the **state program.** The cooperative program has two components: the **RAG** and the **APC.** Under RAG, aquatic plant management costs in federal navigation project areas are 100% reimbursable. Under APC, if a treated water body has public access and a boat ramp, aquatic plant management costs may be reimbursed on a 50-50% basis.

Under the second **(state-funded)** program, money is available for plant control which benefits the public such as flood control systems. Money is reimbursed on a 50-50% basis, according to the "priority level" of the plant(s) controlled (Rule 16C-50). Under the state program in 1986, the Contracts and Grants Section received more than $10 million in reimbursement requests, but had only $3 million available.

[See BUREAU on page 6]

BUREAU [From page 5]

> *Under the state's cost-sharing program, only one- third of the reimbursement money requested was available.*

Under all programs in 1986, the section reimbursed a total of $7.9 million to other government agencies for aquatic plant management purposes.

Most of the reimbursment money pays for herbicidal management; however the legislature has directed that at least $1 million a year be reimbursed for non-herbicide control, research or enforcement.

Grass carp are an eligible expense for reimbursement. And, according to Jubinsky, the section would consider reimbursement for collection and dispersal of biocontrol insects. However, no agency has yet applied for insect collection and release reimbursement.

Endangered Species

In the process of permit review, Jubinsky and his section also reconcile aquatic plant management with the needs of endangered species. This means that the section checks EPA endangered species lists and range maps in an effort to ensure that aquatic plant management has minimal impact on endangered species. Two endangered species, the manatee and the Everglades kite, are of particular concern to the Bureau.

In cooperation with the U.S. Fish and Wildlife Service (USFWS) and local cooperators, the Bureau has established specific management practices where the West Indian manatee may be affected. Because USFWS believes that certain copper containing herbicides may accumulate in manatees, the Bureau and USFWS have formally agreed that aquatic plant control should be conducted to minimize any possible impact on the mammals when they overwinter. Certain restrictions on aquatic herbicide use apply in Citrus County where hundreds of the mammals congregate during cold months. As a further precaution, the Bureau and USFWS require that mechanical control crews include a "spotter" whose job it is to watch for manatees while machines are in operation.

Everglades kites build nests in stands of cattails in the conservation areas in Palm Beach and Broward counties, as well as the southwestern shore of Lake Okeechobee. The Bureau verified reports that kite habitats were being adversely affected by cattail management practices during certain seasons. Consequently, the Bureau is currently working with USFWS to establish criteria for aquatic plant management in critical habitat areas of the Everglades kite.

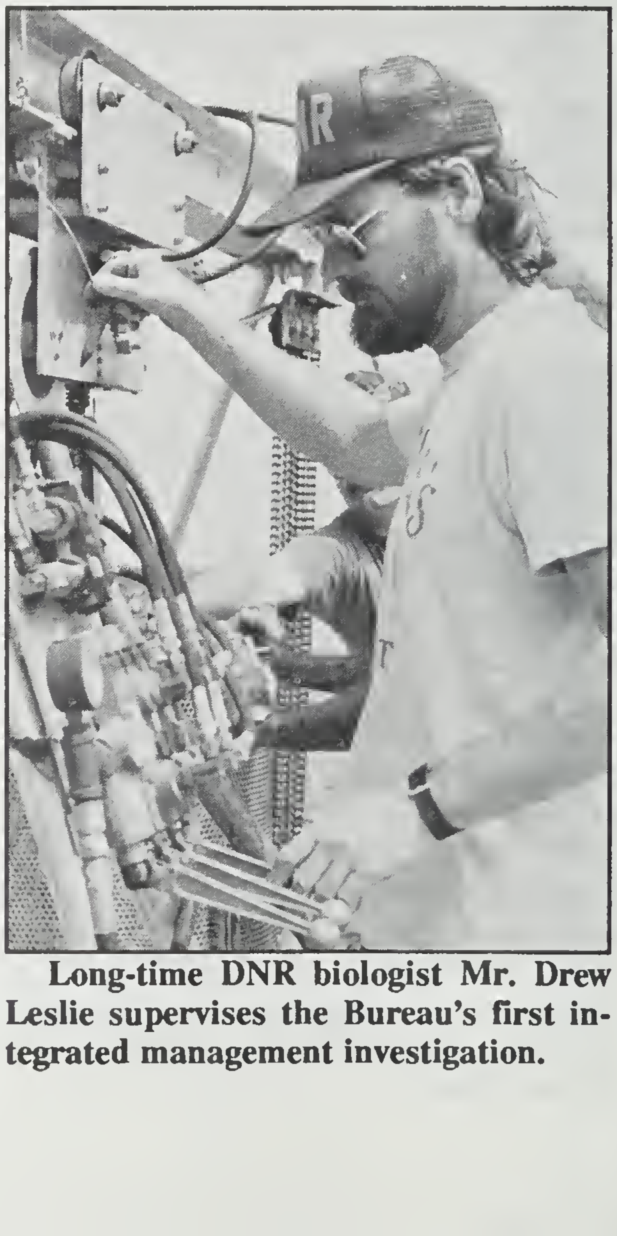
Revegetation

Jubinsky says, "Anything we can do to increase native plants and plant diversity, we ought to be doing." He believes that revegetation with native species would help restore ecosystems which have been damaged by exotic plants such as hydrilla and may help suppress regrowth of exotics. Unfortunately, Jubinsky says, the law does not allow for reimbursement of revegetation project costs.

[See BUREAU on page 7]

Bureau sampling boat.

Bureau research biologists Mr. Rob Kipker and Mr. Hank Smith collect hydrilla samples.



Long-time DNR biologist Mr. Drew Leslie supervises the Bureau's first integrated management investigation.

BUREAU [From Page 6]

RESEARCH AND TECHNICAL SERVICES

The Bureau also maintains a section which conducts research and monitors aquatic plant importation and retail outlets such as aquatic nurseries and pet stores. This section is headed by **Mr. Larry Nall.**

Nall and his small cadre of biologists attempt to answer practical questions which are not addressed in the scientific literature, or which are not answered with Florida's unique environment in mind. Recent such work includes a study of the fate of fluridone in the St. Johns River and a study of fluridone efficacy against a newly introduced exotic plant, *Hygrophila.*

Research Projects

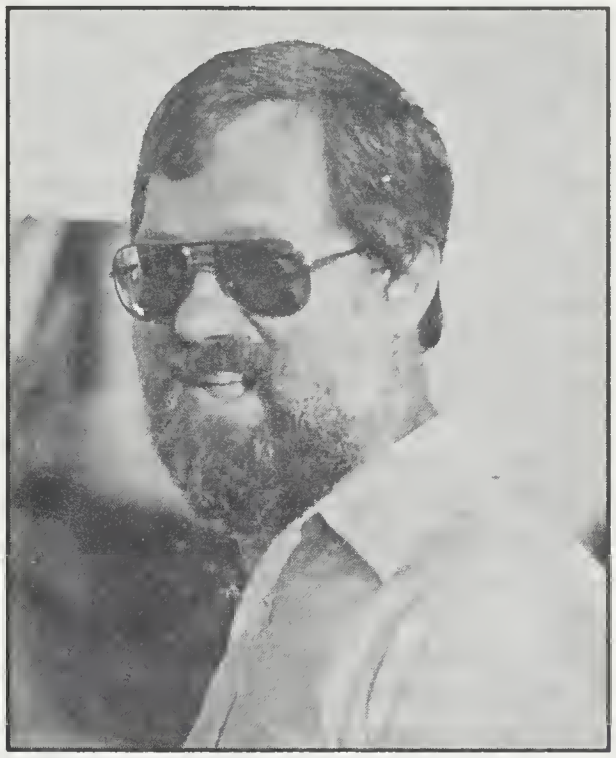
Nall says there are many research projects he would like to see conducted. However, research funding appropriations for the Bureau have been irregular. Until two years ago, no money was allocated for research; for each of the past two years $225,000 has been allocated. No continuing funding is promised, so research projects are conducted on a year-to-year basis.

The section distributed the 1986 appropriation among five projects; algae control, algae physiology, the use of grass carp in flood control canals, revegetation and limnology.

Possible section projects, depending on funding, include:

- Study the fates of copper sulfate and chelated copper.
- Investigate aquatic habitat restoration using transplanted native plants.
- Set up a bioassay laboratory and check the toxicity of adjuvants, which currently require no registration or toxicity data for their use.
- Set up water quality sampling stations at potable water intakes to ensure herbicide use compliance.
- Study the contribution of hydrilla to sedimentation.

V.R.



Regional biologist MR. JOE HINKLE has prepared a computerized list to help managers select appropriate herbicides for specific aquatic plants. 310 records are included in the list, which can be searched according to plant species, herbicide trade names, active ingredients, application rates, water body types, waiting periods and precautions. The list is in dBase III format, and runs on IBM or compatibles. Contact Hinkle for information on availability.

SAVE THE NATIVES!

In a study of the effects of aquatic herbicides on native vegetation, MR. DAN THAYER counts stems in sampling frames. Thayer helps coordinate research and education functions between the Bureau and the IFAS Center for Aquatic Plants.

Regional biologist MS. JUDY LAMIA recently assumed her duties in the Bureau's South Florida Region. Lamia earned an M.S. in limnology and fisheries, under the direction of IFAS Professor Dr. Daniel Canfield.

Her work includes surveying, issuing permits and inspecting aquatic plant management activities for Lake Okeechobee and for the 1500 miles of flood control and irrigation canals of southern Florida.

MR. MIKE DUPES is a biologist with the Jacksonville District of the U.S. Army Corps of Engineers. Dupes keeps track of aquatic plant management needs in Florida's navigable waters for the Corps and makes recommendations to Mr. Pete Milam, Chief of the Natural Resources Management Section of the District.

Among recent activities, Dupes helped draft the agreements between DNR and USFWS which mandate special aquatic plant management programs in the endangered manatee's winter range; represented the District at recent biological control releases against water lettuce and hydrilla; and administers funding for various Corps-sponsored research.

BOOKS/REPORTS

ECOLOGICAL CONSIDERATIONS IN WETLANDS TREATMENT OF MUNICIPAL WASTEWATERS edited by P.J. Godfrey, E.R. Kaynor, S. Pelczarski, and J. Benforado. 1985. Van Nostrand Reinhold Company, Inc., 115 Fifth Avenue, New York, New York 10003. 473 pages. $39.95.

This proceedings contains 31 professional papers addressing "the possible or probable environmental consequences of applying municipal wastewater to wetlands." The workshop was held at the University of Massachusetts, Amherst, on June 23-25, 1982. The seven sessions were Engineering, Ecology, Ecosystem Dynamics, Community Changes, Environmental Health, Long-term Effects and Management. A final session sythesized and concluded the workshop.

K.C. Ewel concluded that the use of wetlands for wastewater treatment is "clearly an attractive alternative to construction and maintenance of advanced wastewater treatment plants." However, Ewel and J.A. Kadlec emphasized the need for more research to more thoroughly explore possible effects and patterns of response before such systems become widespread.

A GUIDE TO THE IDENTIFICATION OF THE FLOATING, SUBMERGED AND PRINCIPAL EMERGENT VASCULAR PLANTS OF THE HANCOCK COUNTY, ILLINOIS, SECTION OF THE MISSISSIPPI RIVER by R.D. Henry. 1985. Western Illinois University Series in the Biological Sciences, No. 12, Macomb, Illinois. 49 pages.

This is an identification guide to 21 species of floating and submersed plants and 40 genera of emergent plants of the area. It includes dichotomous keys, illustrations and diagnostic plant characteristics.

WETLANDS by W.J. Mitsch and J.G. Gosselink. 1986. Van Nostrand Reinhold Company, Inc., 115 Fifth Avenue, New York, New York 10003. 536 pages. $44.95.

This is a comprehensive upper-level textbook that deals with the scientific and management aspects of freshwater and coastal wetlands. The book also is a reference for scientists, engineers and planners involved in the management of wetlands. It emphasizes the many types of wetlands of the United States. The book contains sections which generally review principles and components applicable to many wetland types, and sections that detail the structures and functions of dominant wetland types. Separate chapters discuss history, wetland type definitions, hydrology, biogeochemistry, biological adaptations, and ecosystem development. Chapters describe tidal salt marshes, tidal freshwater marshes, mangrove wetlands, freshwater marshes, northern peatlands and bogs, southern deepwater swamps, and riparian wetlands. A final section discusses wetland management and protection, wetland valuation and wetland classification. An extensive bibliography accompanies the text.

A FIELD GUIDE TO VALUABLE UNDERWATER AQUATIC PLANTS by D.W. Schloesser. 1986. Great Lakes Fishery Laboratory, U.S. Fish and Wildlife Service, Ann Arbor, Michigan 48105. Contribution 644. 32 pages. $3.50.

This colorful field guide is to aid in the identification of common submersed algae and vascular plants in the Great Lakes. An unusual feature of the guide is its handy use of symbols which identify plants' values to animal populations, including fish, birds and various other animals.

A FIELD GUIDE TO COASTAL WETLAND PLANTS OF THE NORTHEASTERN UNITED STATES by R.W. Tiner, Jr. 1987. The University of Massachusetts Press, Amherst, Massachusetts 01004. 248 pages. $25.00 cloth; $12.95 paper.

This field guide contains seven identification keys to plants which inhabit fresh, brackish and saline coastal wetlands of the United States east coast, especially from Maryland to Maine. Illustrations (by A. Rorer), descriptions, flowering periods, habitats and ranges of more than 150 plants are included. The guide is enhanced by the inclusion of a general overview on coastal wetland ecology.

EVALUATION OF THE DIVER-OPERATED DREDGE AND BOTTOM-COVERING MATERIALS FOR CONTROL OF HYDRILLA IN THE POTOMAC RIVER by H.J. Killgore. 1987. U.S. Army Engineer Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi. Miscellaneous Paper A-87-1. 14 pages.

This study determined the time required to dredge a given surface area of hydrilla and the rate of regrowth in dredged areas. It also determined the time required to install bottom-barriers and determined their reduction in plant height and tuber density. The author found that the average time for two divers to dredge an acre of hydrilla to a depth of 2 to 4 inches is 58 hours, at a cost of $17,513. Dredging removed 100 percent of the hydrilla and 91 percent of the tubers. In some instances of dredged high-use areas, hydrilla biomass exceeded control plot biomass within two months after dredging; in less-used isolated areas, only small increases in biomass were measured.

The study found the cost of installing an acre of Dartek to be $11,745; to install an acre of Texel costs $10,875. After one month, tuber density under Dartek and Texel averaged one tuber per square foot, while the control area had five tubers per square foot. The author states that, because of "ballooning", boat damage and sedimentation, both types of bottom-barriers failed to control hydrilla.

PROCEEDINGS of the European Weed Research Society 7th International Symposium on Aquatic Weeds. For this and previous EWRS Aquatic Weeds Symposia proceedings, contact: Dr. H. Gortz, EWRS Proceedings Symposia, Postbus 14, NL-6700 AA Wageningen, THE NETHERLANDS. Price is 35 Swiss francs.

THE SMITHSONIAN GUIDE TO SEASIDE PLANTS OF THE GULF AND ATLANTIC COASTS FROM LOUISIANA TO MASSACHUSETTS, EXCLUSIVE OF LOWER PENINSULAR FLORIDA by W.H. Duncan and M.B. Duncan. 1987. Smithsonian

[See BOOKS/REPORTS on page 9]

BOOKS/REPORTS

[From page 8]

Institution Press Books, P.O. Box 4866, Hampden Station, Baltimore, Maryland 21211. (301) 338-6963. 400 pages. $45.00, cloth; $29.95, paper.

This is a "definitive guide" to one thousand species of wildflowers, trees, shrubs, grasses, rushes and sedges. Plants of beaches, dunes, wetlands, and barrier islands from the Gulf States to Massachusetts are included. The book includes keys, scientific and common names, descriptions, and illustrations of flowering, fruiting and vegetative structures. A special feature is the section of six hundred color photographs.

PLANT LIFE IN AQUATIC AND AMPHIBIOUS HABITATS; A Tribute to D.H.N. Spence, edited by R.M.M. Crawford. 1987. Special Publication, British Ecological Society, Koeltz Scientific Books, P.O. Box 1360, D-6240 Koenigstein/Taunus, Federal Republic of Germany. 452 pages. DM 166.

This is the proceedings of a special symposium held by the British Ecological Society in March, 1985. The physiological ecology and problems encountered by both crops and natural flora under soil flood or tidal flood conditions formed the discussion of this international meeting.

THE CONTRIBUTION OF SILVER CARP HYPOPHTHALMICHTHYS MOLITRIX TO THE BIOLOGICAL CONTROL OF RESERVOIRS, by H. Leventer. 1987. Mekoroth Water co., Jordan District, Central Laboratory, Nazareth Ilit 17105, ISRAEL. 106 pages.

This booklet describes the results of research on the use of fish to control algae and macrophytes in several Israeli reservoirs. Much of the data relates to the use of silver carp to manage algae and describes silver carp's growth rate, consumption of phyto- and zooplankton, and its effects on water quality.

FIELD GUIDE FOR LOW-MAINTENANCE VEGETATION ESTABLISHMENT AND MANAGEMENT, by Environmental Laboratory. 1986. U.S. Army Corps, Waterways Experiment Station, P.O. Box 631, Vicksburg, Mississippi 39180-0631. Instruction Report R-86-2, 145 pages.

This handy guide refers to terrestrial situations, however some of its content could be applicable to shoreline vegetation establishment and management. It is written for resource managers who do not have extensive knowledge of soil and plant sciences. Sections of the report help resource personnel select and maintain appropriate vegetation types for certain soil, terrain and site uses. It emphasizes desirable, low-growth, low-maintenance species.

BIOLOGICAL SERVICES PROGRAM

The Biological Services Program "was established to supply scientific information and methodologies on key environmental issues that impact fish and wildlife resources and their supporting ecosystems." The program is within the U.S. Fish and Wildlife Service, U.S. Department of the Interior, Washington, D.C. 20240.

Projects relevant to aquatic plant research and management have been initiated in several areas of investigation, including water resource analysis, stream alteration, coastal ecosystems, habitat classification, and systems inventory, including the National Wetland Inventory.

"National Teams", such as the National Coastal Ecosystems Team, provide the Program's central scientific and technical expertise and arrange for contracting biological services studies with states, universities, consulting firms and F.W.S. research facilities.

Reports and a publications list are available from: Publications Officer, United States Department of the Interior, Fish and Wildlife Service, National Coastal Ecosystems Team, 1010 Gause Boulevard, Slidell, Louisiana 70458. Single copies are free upon request.

MEETINGS

22nd ANNUAL REVIEW MEETING, AQUATIC PLANT CONTROL RESEARCH PROGRAM, U.S. ARMY CORPS OF ENGINEERS. November 16-19, 1987, Portland, Oregon. For more information, contact Mr. William Rushing, CEWES-ET-A, U.S. Army Corps of Engineers, P.O. Box 631, Vicksburg, Mississippi 39180. (601) 634-3542.

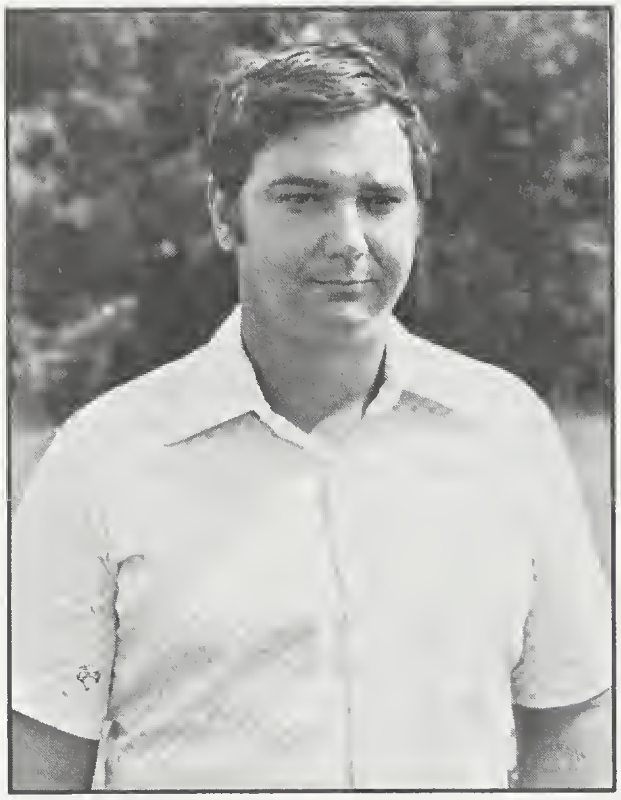
15th ANNUAL CONFERENCE ON WETLANDS RESTORATION AND CREATION. May 19-20, 1988, Tampa, Florida. For more information, contact Mr. Fred Webb, Hillsborough Community College, Plant City Campus, 1206 North Park Road, Plant City, Florida 33566. (813) 754-1561.

SYMPOSIUM ON HABITAT MANAGEMENT FOR MIGRATING AND WINTERING WATERFOWL IN NORTH AMERICA. January 24-28, 1988, Jackson, Mississippi.

This symposium seeks to assemble information on state-of-the-art management practices in habitats used by migrating and overwintering waterfowl. For more information, contact:Wintering Waterfowl Symposium, Department of Range and Wildlife Management, P.O. Box 4169, Texas Tech University, Lubbock, Texas 79409. (806) 742-2842.

INTERNATIONAL SYMPOSIUM ON LAKE AND RESERVOIR MANAGEMENT, NORTH AMERICAN LAKE MANAGEMENT SOCIETY. November 3-7, 1987, Orlando, Florida. For information, contact NALMS, 1000 Connecticut Avenue N.W., Washington, D.C. 20036. (202) 833-3382.

A LITTLE CLOSER



Profile of Dr. William T. Haller, Professor of Agronomy, IFAS Center for Aquatic Plants, University of Florida.

When *Hydrilla* was first introduced into Florida about 25 years ago, a handful of scientists recognized its destructive potential and predicted its spread into areas where "aquatic weeds" had never been known. Within a few years, thick mats of hydrilla appeared throughout Florida, a state problem. When hydrilla more recently moved north, infesting the Washington Monument reflection pool and the nearby Potomac River, U.S. Congressmen decided it was a national problem. "New studies" of hydrilla were ordered, creating "experts" on hydrilla from here to Timbuktu.

Bill Haller *is* an expert on hydrilla. In fact, he has studied hydrilla longer than most people have known its name. Over the years, he has authored and co-authored more than 100 papers and reports about waterhyacinths, hydrilla and other aquatic plants. Haller has investigated hydrilla's photosynthesis, germination and reproduction, methods of spread, effects of growth regulators, and effects of salinity on plant growth. He also has conducted studies to control hydrilla by drawdowns and mechanical methods. More recently, Haller has devoted much of his work to herbicidal control of the plant.

In his 1974 doctoral dissertation on the photosynthetic characteristics of hydrilla, Haller reported research results which began to answer the question of how the plant so easily dominates Florida's native submersed plants. During his study, Haller found that hydrilla uses photosynthetic carbon in ways unlike those of plants in the C_3 or C_4 photosynthetic groups. Haller concluded that hydrilla has photosynthetic characteristics of both groups, a finding which helped lead to world-wide intensive research on the unique growth capabilities of submersed plants.

Besides being able to grow in extremely low light, hydrilla has other growth weapons at its disposal: tubers and turions, "the most important sources of hydrilla regrowth." Haller and others have studied the seasonal production and germination of these reproductive parts, finding that hydrilla produces tubers and turions during the winter months when vegetative growth is low, and produces few tubers and turions in warmer months, when vegetative growth is high. His research found that mature tuber germination approaches 100% when water temperatures rise above 65° F (and carbon dioxide and oxygen levels in the hydrosoil are adequate). Prolific and efficient tuber and turion production and germination is another reason hydrilla so easily dominates native submersed plants.

Haller believed that mechanical methods of control could not keep up with hydrilla growth, could not remove tubers from the hydrosoil and could even help spread hydrilla by fragmentation regrowth, so he began to concentrate his research on herbicidal control of hydrilla. In recent years, he has studied the efficacy of several herbicide formulations for hydrilla control, including endothall, fenatrol, diquat and fluridone. Much of his work has been concentrated on the use of fluridone formulations, concentrating on "sublethal dose" management of hydrilla.

Besides being an active researcher, Haller has directed and worked with graduate and post-doctoral students from the United States, India, England and The Netherlands. He is a founding member of the the Florida Aquatic Plant Management Society (11 years old this year) and remains an active member. He also is editor of the Journal of Aquatic Plant Management of the National Aquatic Plant Management Society.

Haller received his bachelor's degree from Cornell University and his advanced degrees from the University of Florida. He has lived in Gainesville since 1969 with his wife, Jean. They have three children, Will, Doug and Missy.

CURRENT RESEARCH OF WILLIAM HALLER

- With Dr. Alison Fox; the determination of the best times to apply herbicides to control *Hydrilla* in flowing waters (see TIDES AND HERBICIDES in this issue)
- With Fox; the investigation of the germination and growth ecology of *Zizaniopsis miliaceae*, a grass which is forming floating islands that are interfering with navigable waterways
- With Dr. Ken Langeland; the investigation of *Polygonum* control in drawdown situations
- With Dr. Donn Shilling; a residue study of fluridone up to 3 miles from the application site in a large lake
- With Shilling; the determination of "no effect" levels of diquat on non-target aquatic plants and terrestrial crops, and the study of torpedo grass resistance to diquat
- With Shilling; an investigation of the effects of calcium content (water hardness) on glyphosate efficacy for aquatic grass control.
- Investigation of fluridone efficacy for hydrilla tuber control in drawdown situations

Dr. William T. Haller
Center for Aquatic Plants
IFAS, University of Florida
7922 N.W. 71st Street
Gainesville, Florida 32606
(904) 392-9613

AQUATIC PLANT MANAGEMENT AND ENDANGERED SPECIES

Some aquatic plant managers wondered aloud whether they themselves could become an endangered species after they learned of plans of the E.P.A. and the U.S. Fish and Wildlife Service. The two federal agencies are attempting to comply with legislation which disallows the use of certain pesticides in habitats of endangered and threatened plants and animals of the U.S. The new pesticide-use rules currently being promulgated may significantly affect efforts to manage exotic aquatic weeds such as hydrilla and waterhyacinths.

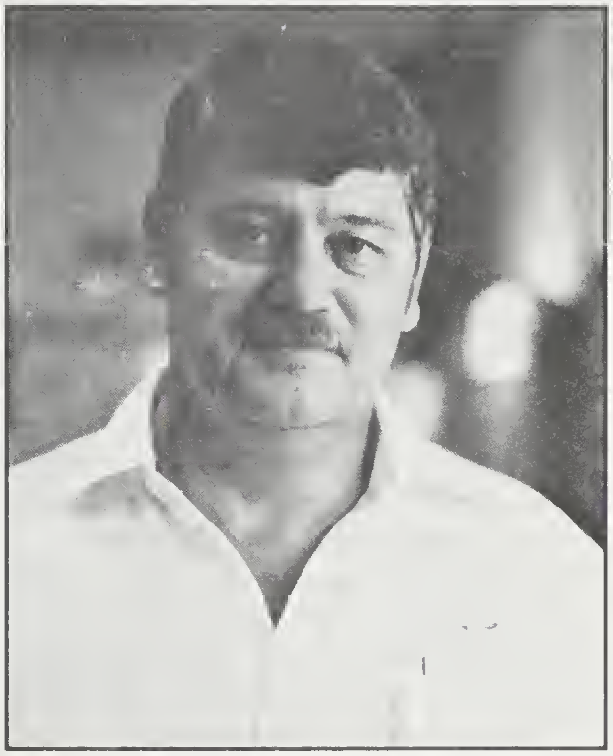
More than 360 delegates to the annual meeting of the **Florida Aquatic Plant Management Society** heard the E.P.A.'s Mr. Carlton Layne explain that additional pesticide-use restrictions are being imposed throughout the U.S. and apply to all people who use pesticides within ranges of protected plants and animals. The "aquatics cluster" rules are just now being formulated and may go into effect in 1989.

The feelings of the Society may best be represented by one applicator who spoke: "Wouldn't allowing waterhyacinths to cover shorelines and replace native vegetation further degrade the wood stork's habitat and make them even more endangered?"

FAPMS President-elect Eddie Knight promised to bring such questions to the attention of policy-makers, and to make the issue a priority of his administration. He also appointed Dr. Joe Joyce to work with the EPA and FWS in elaborating the new rules.

During the three-day meeting October 20-22, environmental, public health and public education issues also were discussed in talks by officials of several state and regional agencies.

FAPMS President Mike Mahler passed the gavel to Mr. Eddie Knight. Mr. Bill Moore is the new President-elect, Dr. Joe Joyce and Mr. Brian Nelson continue as secretary and treasurer, respectively.



Mr. Larry Maddox. The very active FAPMS arrangements chairman.

The 11th Annual Meeting of the Florida Aquatic Plant Management Society in Daytona Beach. More than 360 attended the three day meeting.

TIDES [From page 1]

determine dilution and dispersal rates of aquatic herbicides in freshwater tidal canals.

The scientists are conducting these studies on four spring-fed, residential canals (Three Sisters) which connect to King's Bay in Citrus County, Florida. As Gulf of Mexico tides rise, fresh water in the canals is held back causing canal tides. As Gulf tides recede, canal water is released.

For these studies, Fox and Haller are using fluorescing dyes to mimic herbicide application, dilution and dispersal. Dye was chosen over herbicides because dyes are less expensive, faster and easier to apply, and readings can be taken instantly in the field, rather than sending samples to the laboratory.

Rhodamine W.T. dye is applied (at the rate of 10 ppb) at various times according to tidal fluctuations. The investigators then draw water samples into a fluorometer-spectrophotometer that measures fluorescence with an accuracy to 10 parts per trillion. The results enable them to map dye movement and determine dilution rates in direct relation to tides.

When the study is complete, the increased knowledge of water movement characteristics will help Fox and Haller to recommend herbicide application times for *Hydrilla* management in tidal and flowing water situations.

Drs. Fox and Haller are with the IFAS University of Florida Center for Aquatic Plants. The work is being conducted in cooperation with the Army Corps of Engineers Waterways Experiment Station (Aquatic Plant Control Research Program), the Jacksonville District of the Corps, and Citrus County government agencies.

BASS, GRASS CARP AND HYDRILLA

Many fishermen believe good bass fishing lakes require the presence of submersed plants. However, if Florida Lakes Baldwin and Pearl are good examples of bass fishing lakes, then this belief may be wrong. For more than 7 years these lakes have been devoid of submersed plants, yet largemouth bass populations are at the same or higher levels now than when submersed plants were plentiful.

Mr. Douglas Colle and Dr. Jerome Shireman have been observing these lakes as part of a long-term study of the effects of grass carp stocking and the resulting submersed plant loss on native fish population dynamics. Their results are soon to be published. Colle and Shireman are with the Department of Fisheries and Aquaculture, IFAS - University of Florida.

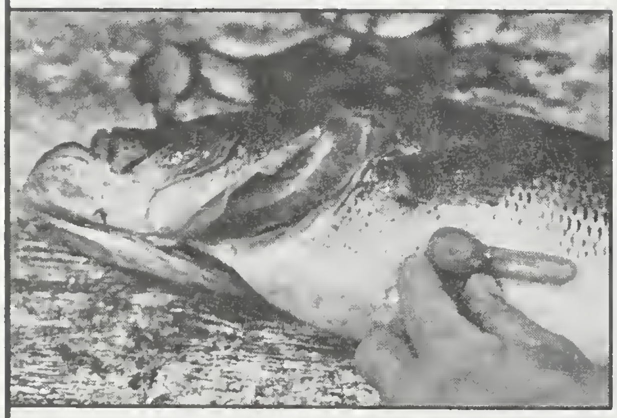
In the late 1970s, Lakes Baldwin and Pearl had 70% and 95% hydrilla cover, respectively. Grass carp were released into the lakes at 13 and 17 fish per acre. By the early 1980s, no submersed plants remained in either lake. The grass carp remain and continue to remove submersed vegetation as it re-appears.

Some results:

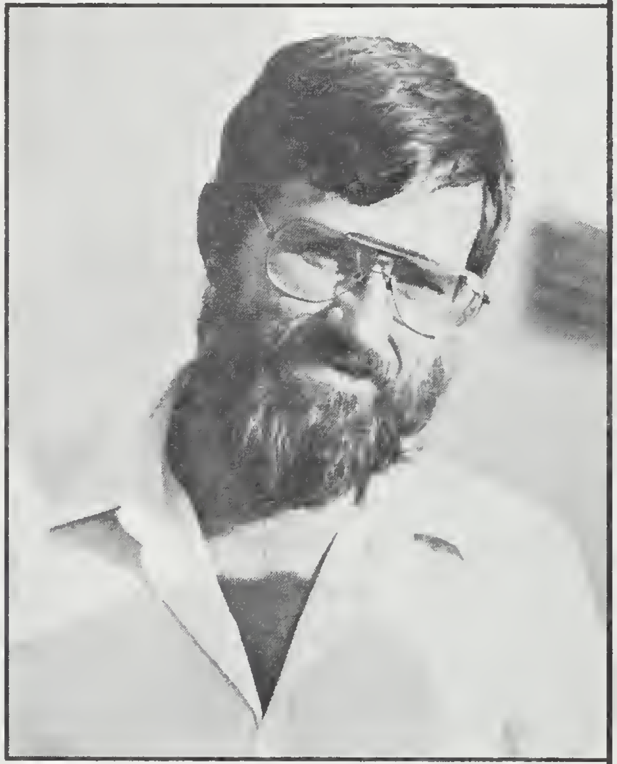
- Radiotelemetry studies of largemouth bass movement shows that 40% of the adults spend the majority of their time in the middle, deeper parts of the lakes, instead of near the shores.
- As hydrilla was consumed by grass carp, there were immediate, significant decreases in non-game fish species such as chubsuckers, blue spotted sunfish, golden shiners and goldentop minnows. These fish populations have not recovered.
- Blue gill and redear fish populations have remained constant or have increased since introduction of grass carp.
- Bass populations were not impacted by grass carp introduction or submersed plant elimination because the bass forage base (bluegills, redear) remained intact.
- The food bases in the lakes shifted from insects and zooplankton which are dependent on vegetation, to insects which do not require vegetation. The latter insects were always present, but are now dominant.
- Water clarity in the lakes changed from six meter Secchi depths to one and a half meter Sechhi depths.

In other research, Colle and Shireman are testing lower grass carp release rates in several lakes in order to manage, not eliminate, submersed plants. In other lakes, they are using grass carp to control *Spirodela* and *Eleocharis.*

Colle is a biological administrator with degrees in fisheries biology; he has been with IFAS since 1974. Contact Colle at the Department of Fisheries and Aquaculture, IFAS - University of Florida, 7922 N.W. 71st Street, Gainesville, Florida 32606. (904) 392-9613.



For movement studies, radio antennae are surgically attached inside largemouth bass.



MR. DOUGLAS COLLE

CHESAPEAKE BAY BIBLIOGRAPHY

The **Chesapeake Bay Bibliography** is a database of 8,000 citations on the science, history, technology and management of the Bay environmments. The database may be accessed free of charge by modem or by mail. It is supported by the College of William and Mary and the Virginia Institute of Marine Science, and funded by the Maryland Department of Natural Resources.

A recent keyword search of the database for marsh plants, eelgrass, seagrass, aquatic weeds or submerged plants yielded 270 citations.

Geographic coverage of the CBB encompasses the entire Bay and its tributaries and extends to the offshore waters of the Delmarva Peninsula. Source publications have been monitored since 1971 for relevant materials and earlier bibliographies have been searched. Coastal zone management material has been included since 1975. The database is updated every six months.

Cited materials include primary journals in the marine and environmental sciences, monographs, symposia, dissertations, theses, selected institutional and governmental reports, newspapers and secondary sources. Citations include accession number, author, title, date, journal reference and keywords. The database may be searched by author name, subject, keywords or string searches, and is subject indexed for online searching.

Users can access and search the system from a remote terminal with a PC and modem using the Maryland DNR CHESSEE network. Search results may be printed at the Chesapeake Bay Liason Office and sent to users free of charge. Users may dial 301/841-5264, log on as "Citizen", and use "CBP" as the password.

For more information, write the **Chesapeake Bay Bibliography, VIMS Library, The College of William and Mary, Gloucester Point, Virginia 23062, or call 804/642-7116.**

ONE EXOTIC DESTROYS ANOTHER

Tiny imported insects have wiped out two million tons of *Salvinia molesta,* prompting investigators **P.A. Thomas** and **P.M. Room** to announce " . . . the most outstanding example of biological control of an aquatic weed."

The noxious plant has been virtually eliminated from the floodplain of Papua New Guinea's Sepik River *(see Social Consequences of* Salvinia *Infestations in Papua New Guinea, AQUAPHYTE 6(1):7 1986).* According to Thomas and Room, the imported beetles wiped out the pest plant within one year of the widespread distribution of some 900,000 insects (see *Successful Control of the Floating Weed* Salvinia molesta *in Papua New Guinea: A Useful Biological Invasion Neutralizes a Disastrous One. Environmental Conservation 13(3):242-248 1986).* Ecologies of the infested water-bodies and the lives of the people who depend on them have been restored to their conditions prior to invasion by the floating fern in the early 1970s.

Village lagoons that were recently completely covered by *Salvinia* had been abandoned because the severity of infestation prohibited transportation and fishing. The 80,000 people living in the floodplain are totally dependent on water transport for access to markets, schools, medical facilities, and food sources because of seasonal flooding, extensive swamps, and absence of roads. Thomas and Room report that abandoned villages have now been reoccupied.

Control of *Salvinia* was accomplished by introduction of the beetle, *Cyrtobagous salviniae* (originally thought to be *C. singularis*). The adults feed on *Salvinia* buds and the larvae tunnel through buds and rhizomes. Successful use of the beetle in controlling *Salvinia* on Lake Moondarra in Australia suggested its use in Papua New Guinea (see *Beetle Destroys* Salvinia, *AQUAPHYTE 2(1):1 1982*).

Cyrtobagous salviniae was cultured in Binatang Lagoon in 1982 and by May 1983, sufficient numbers were available to transport *Salvinia* containing all life-stages of the beetle to other lagoons. By November of the same year, these secondary populations had increased enough to allow further redistribution. By May 1985, some 900,000 adult, and unknown numbers of immature, *C. salviniae* were distributed among 160 floodplain sites. The effort was made easier by local people who responded to radio announcements asking them to collect beetle-infested *Salvinia* from central points.

In most lagoons, a single release of beetles resulted in establishment within 5 to 7 months. Problems did occur where mats of the weed had become very thick and were colonized by other vegetation into sudd. In this case, the mat was sprayed aerially with Paraquat which killed and sank the sudd, leaving a thin cover of *Salvinia* which induced a rapid increase in the beetle population. Despite the huge biomass of *Salvinia* which was killed and sunk, no adverse effects on water quality, such as algal blooms, were observed. Approximately one year after the beetles cleared two main lagoons of *Salvinia* mats, the only *Salvinia* remaining was present as tiny, primary growth form plants scattered among marginal vegetation. Re-establishment of native aquatic vegetation occured shortly after the removal of *Salvinia*.

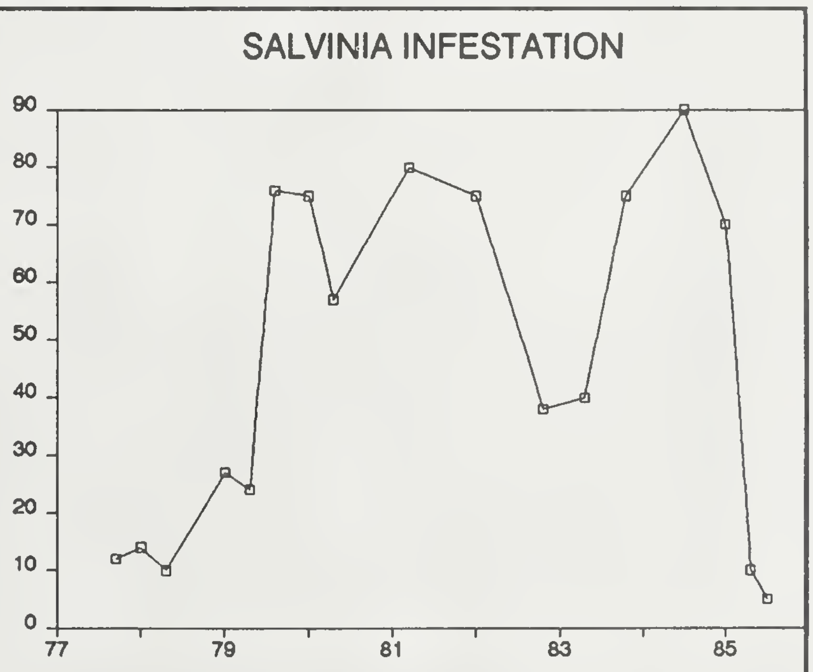
In the year following widespread redistribution of the beetle, between mid-1984 and mid-1985, the infestation was reduced from nearly 250 km^2 of *Salvinia* mat to less than 2 km^2, a reduction of some 2 million tons of weed.

Thomas and Room believe that *Salvinia molesta* now will be merely a minor component of the aquatic flora of Papua New Guinea due to biological control by *Cyrtobagous salviniae.*

K.B.

"The most outstanding example of biological control of an aquatic weed."

This graph shows the percent area of water in the Sepik River floodplain covered by *Salvinia.* Nine hundred thousand beetles *(Cyrtobagous salviniae)* were widely distributed in the floodplain in early 1983. By mid-1985, complete *Salvinia* control was achieved.



TWO MORE AQUATIC PLANT NEWSLETTERS

The **EXTENSION AQUATIC WEED CONTROL NEWSLETTER** is a service of the Florida Cooperative Extension Service, IFAS, University of Florida. Its purpose is to alert readers to new rules and legislation about aquatic plant management as well as new label changes for commonly used aquatic herbicides. The newsletter also announces meetings and plant management courses.

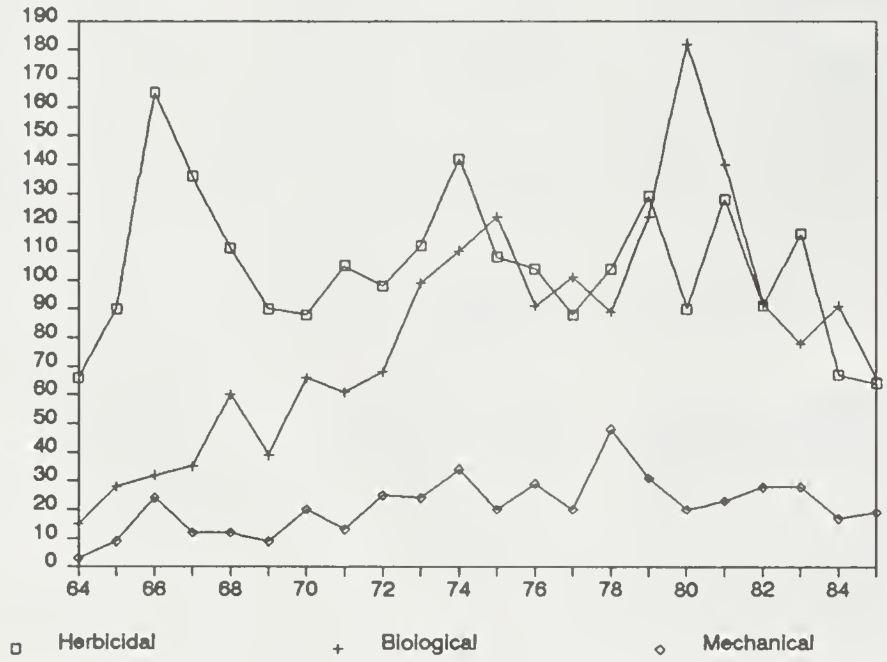
The newsletter is free. To be placed on the mail list, contact Dr. K.A. Langeland, editor, at the Center for Aquatic Plants.

POTOMAC SAV NEWS is a newsletter about submersed aquatic vegetation (SAV) in the metropolitan Washington (D.C.) area. It presents news of interest especially about the recent infestations of hydrilla in the area. It is produced by the Metropolitan Washington Council of Governments, and is supported with funds from the Federal/State Aquatic Plant Control Program. It is free. Contact the Department of Environmental Programs, MWCOG, Suite 200, 1875 Eye Street N.W., Washington, D.C. 20006.

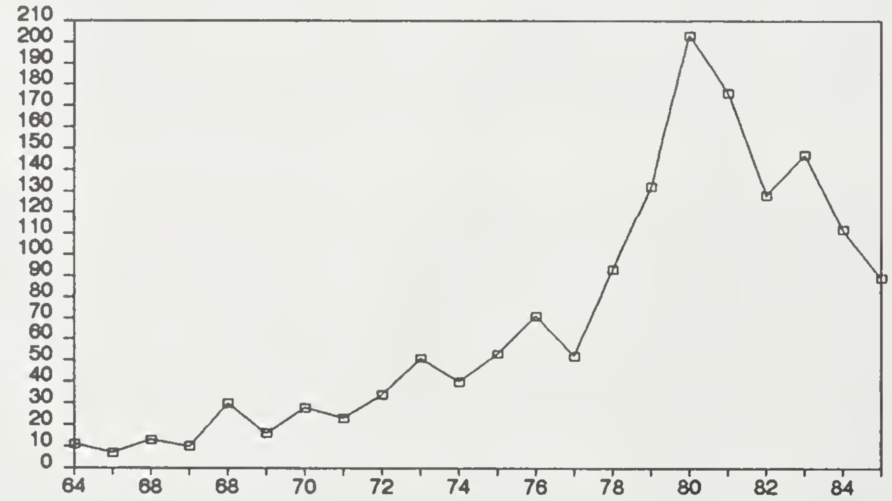
UPS AND DOWNS OF AQUATIC PLANT RESEARCH

Literature reviews about aquatic plants and their management are being prepared in increasing numbers. In many cases, these reviews are used to convince funding agencies of the value of proposed research or to identify "gaps" in the research. Many users appreciate even more the value of the **Aquatic Plant Information Retrieval System (APIRS)** when they are preparing literature reviews. APIRS, part of the IFAS Center for Aquatic Plants, provides free of charge retrospective and current awareness bibliographies of the literature to many government and private entities. Recently, we conducted a citation count for areas of research represented in our database of more than 25,000 aquatic plant articles, books and reports. Some of the results, which may indicate research trends of interest to our users and readers, are graphed below. The Y axis indicates numbers of citations in the database; the X axis indicates publication years. APIRS, 2183 McCarty Hall, IFAS - University of Florida, Gainesville, Florida 32611. (Graphs: Stefanie Malin)

CONTROL METHODS



UTILIZATION



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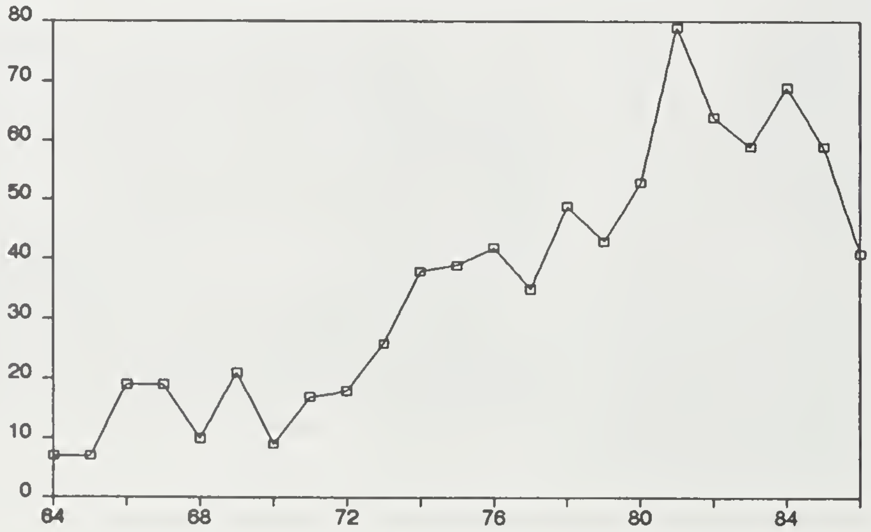
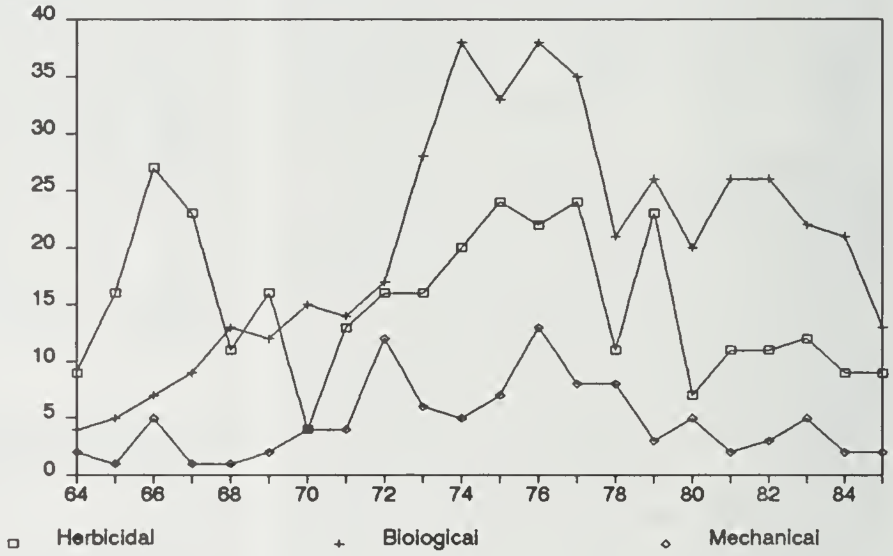
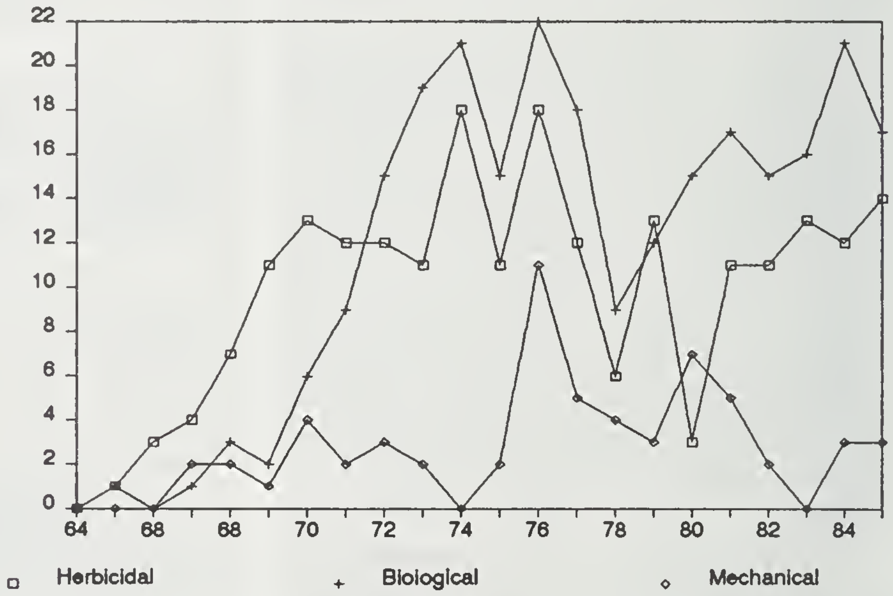


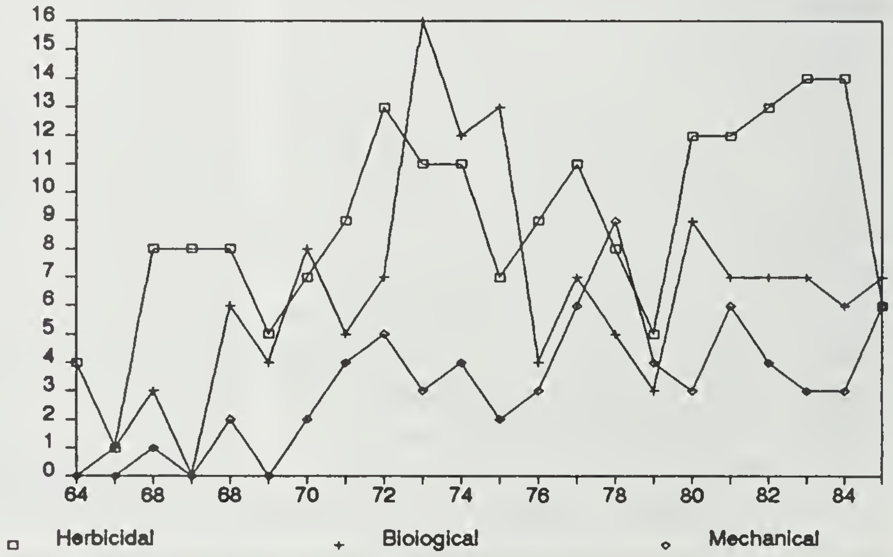
WATERHYACINTH MANAGEMENT



HYDRILLA MANAGEMENT



EURASIAN WATER MILFOIL MANAGEMENT



SPECIAL REPORT

APPLIED ELECTRONECROPHYTOLOGY -- STUNNING NEW AQUATIC PLANT MANAGEMENT METHOD; PUBLIC RELATIONS DREAM

Aquatic plant management researchers world-wide are discussing recently released data on a new management method, Megaelectrical Point Discharge **(MEPD).** The method promises not only to eliminate "aquatic weeds" but also to replace public fear and skepticism about aquatic weed management with joy and anticipation.

MEPD is the brainchild of **Dr. Ragtop Prababababagous,** the noted authority on plant electro-communication and electronecrophytology, the science which studies the death of plants by electricity. Others co-opted into the study are **Dr. Hans Beetlemania, Dr. Beta (Ray) Willsin, Dr. Herbie Sides,** and **Dr. No Hy Droh.** Willsin, of the **Mechano-electrohydrobotanical Institute,** is the chief designer of the experimental apparatus; Beetlemania the chief theoretician; Sides the chief ecological consultant, and Hy Droh the chief public relations consultant. A consortium was necessary because no single country could afford the cost of gathering the many quick minds required and developing the ultra-sophisticated technical hardware necessary to test the new method. The **Bartram of Zultania** graciously donated the test site which is located 140 miles from anywhere.

In simple terms, megaelectrical point discharge employs the use of 12 foot electrodes placed at each end of the aquatic plant infested waterbody. Electrical power is applied and plants are instantly vaporized. No further treatment is required as no biomass of any kind remains.

The method requires the use of several megawatts of power, depending on the size of the treated areas. For the 80 ha. experimental lake, 38 megawatts were necessary to reduce a waterhyacinth infestation (density of 150 m.t./ha) to white phosphatic powder. In the experiment, all power of the country of Zultania was temporarily diverted to the apparatus. Field personnel for the project have been subducted from the ranks of unemployed capital punishment technicians, in plentiful supply in Zultania since electrocution was deemed non-energy-efficient. Morale is high among the newly employed aquatic plant control technicians, known as Wattheads, who feel they are on the cutting edge of a new technology. Wattheads are seen sporting caps which read, "*More Power to 'Em!*" and bumper stickers stating that "*Wattheads are Live Wires*!"

PUBLIC SUPPORT

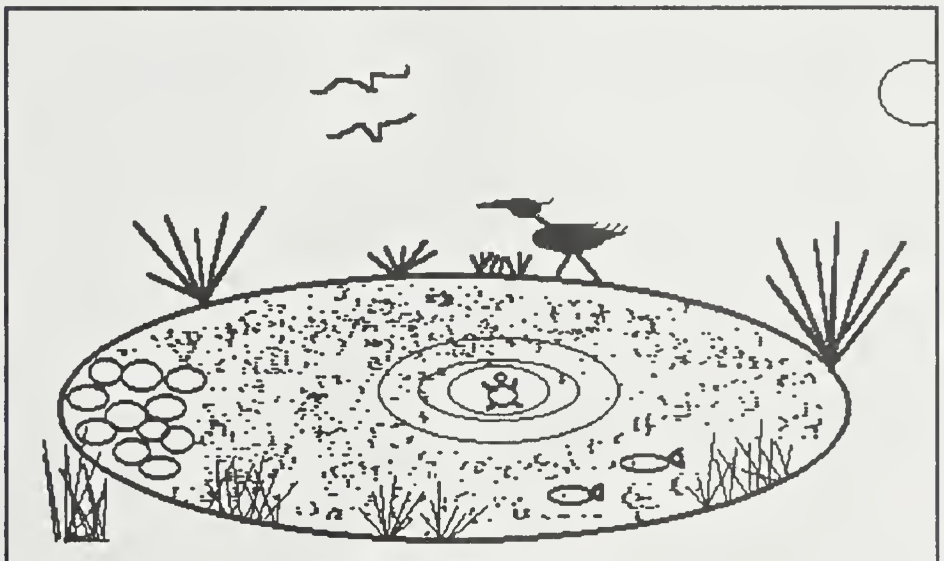
ELECTROMANIA. A bane to the use of other aquatic plant management technologies is negative public sentiment. Not so with MEPD. When not in use as a plant management tool, the electrodes can be used by nearby communities for entertainment purposes: citizens can enjoy the stunning visual effects of "zapping" everything at once within a large area. Nighttime viewing is especially exciting as thousands of organisms vaporize, each with its own distinctive shape and color. "It's better than any fireworks I've ever seen," exclaimed one jubilant spectator present at the test site, Ms. Judith Kouche-Potatto.

OTHER BENEFITS

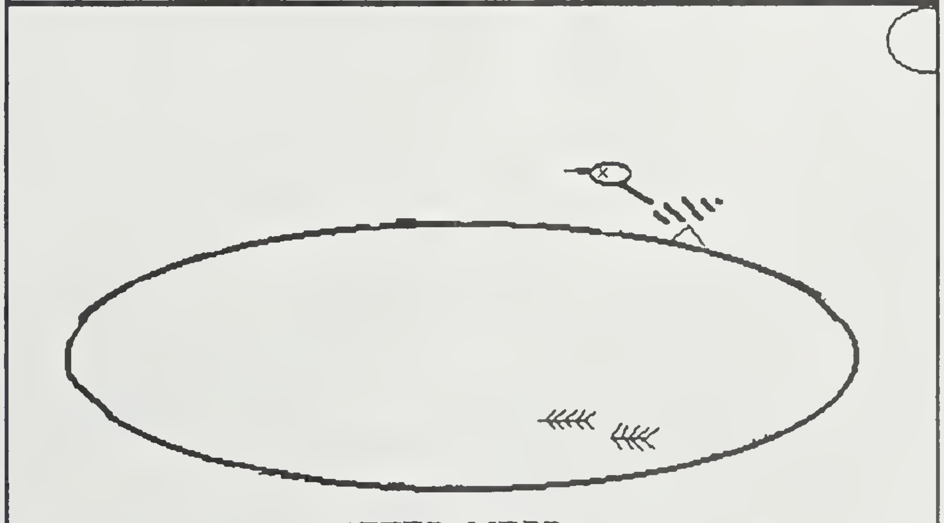
EVAPORATIVE DRAWDOWNS. Other uses of the MEPD include evaporative drawdowns, achieved by heating waterbodies to high temperatures in order to evaporate excess water. However, controlling the rate of drawdown and restoring the waterbodies to pre-drawdown levels has not as yet been perfected. Specialists agree that more research is needed in the areas of application rate and water reconstitution. Nevertheless, The Zultanian Cadre is anxious to test the method anyway, and has targeted a small urban community's water supply lake as the first test site. Boiled fish will be distributed among residents to offset any complaints of a water shortage.

NON-WATER SPORTS. The evaporative characteristics of the MEPD have also been considered for use in preparing fields for the Zultanian national sport, Basin Ball. Basins for the popular sport have a tendency to fill up with water following heavy rains. After evaporating all water from the basins, the electrodes can be left in place and utilized for illuminating nighttime games and eliminating pesky insects, further engendering public support for this state-of-the-art apparatus.

SHINY OBJECTS. Another beneficial spinoff of the MEPD is the possibility of electroplating anything placed within the waterbody to be treated.



BEFORE MEPD



AFTER MEPD

AQUAPHYTE

AQUAPHYTE is the newsletter of the Center for Aquatic Plants and the Information Retrieval System of the University of Florida Institute of Food and Agricultural Sciences (IFAS). Support for the information system is provided by the Florida Department of Natural Resources and by the U.S. Army Corps of Engineers Waterways Experiment Station Aquatic Plant Control Research Program (APCRP).

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AQUAPHYTE is sent to 3,500 U.S. and Canadian managers, biologists and agencies. Comments, announcements, news items and other information relevant to aquatic plant research are solicited.

We gladly permit free republication of **AQUAPHYTE** items when accompanied by full acknowledgement.

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PESTICIDE INFORMATION

The University of Florida IFAS **Pesticide Information Office** has a new coordinator, **Dr. O. Norman Nesheim.** Dr. Nesheim joined the University of Florida on July 1, after serving as Pesticide Coordinator for nearly 13 years at Oklahoma State University.

Functions of the Pesticide Information Office include the development of examination and training materials for the Certified Pesticide Applicator courses offered through the County Extension Agent offices. The office also writes and distributes informational brochures such as the Pesticide Applicator Training Update which contains new information on the Florida Pesticide Law and Rules, pesticide disposal, handling of spills, endangered species restrictions, safety and warning posters and emergency telephone numbers.

CHEMICALLY SPEAKING is a monthly newsletter published by the Pesticide Information Office. It covers the latest developments in pesticides, including government regulation and new or pending legislation, application restrictions and exemptions, new, recalled or discontinued products, information on violations, and availability of educational materials such as videotapes on safety, proper handling, mixing and storage of pesticides, information updates and safety packets.

CHEMICALLY SPEAKING is available free to all interested parties by calling (904)392-4721 or writing Dr. Nesheim at the Pesticide Information Office, Building 847, University of Florida, Gainesville, Florida 32611.

Other aquatic pesticide publications available from IFAS include:
Pesticide Applicator Training (PAT) Update
Applying Pesticides Correctly
Pesticide Safety Packet
Aquatic Plant Control Manual
Aquatic Plant Control Reference Manual
Aerial Applicator Training Manual

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